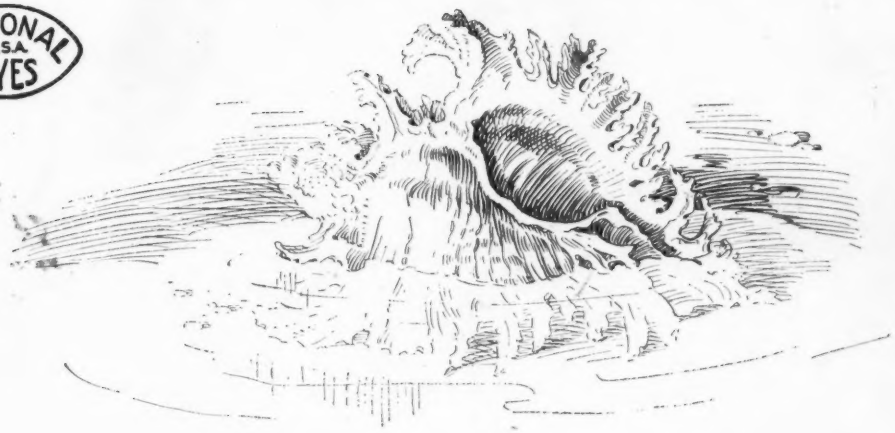
TEXTILES PAPER LEATHER

AMERICAN DYESTUFF REPORTER

Including the Proceedings of the
AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

VOLUME XI SEPTEMBER 11, 1922 NUMBER 6

NATIONAL U.S.A. DYES



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Old Man "Good Enough" Sees the Handwriting on the Wall

OLD MAN GOOD ENOUGH was the offspring of Textile Prosperity and the parent of Waste and Inefficiency. He was old looking and infirm even at birth, but his parent Prosperity said he was "Good Enough."

Textile Prosperity pampered and stuffed Good Enough until he grew fat and more spoiled and shiftless than ever. Good Enough wasted his parent's earnings recklessly, shamelessly, thousands and thousands of dollars a year.

Quietly and unobtrusively he slunk out of the door and has not been seen since.

People warned Textile Prosperity regarding Good Enough's recklessness, pleaded with him to cast out the prodigal son. They pointed to Efficiency, a one time acquaintance of Textile Prosperity, and said, "Make him your favorite. He can save you thousands of dollars which Good Enough is now wasting." But Textile Prosperity turned a deaf ear to all these pleadings, and answered with a smug smile, "I'm making lots of money. I guess Good Enough is 'good enough for me.'"

But there came an end. Textile Prosperity sickened from too much of everything and died. He was succeeded by Depression, who remained in authority for many months and who still pampered Good Enough, partly from precedent and partly because he was too weak to do otherwise.

Then Efficiency, who had been growing weak from neglect and inactivity, began to realize the great need for his guiding hand and by an heroic effort pulled himself together and took command. He assembled about him those who had previously advised Textile Prosperity in vain and found in their words much that was good; particularly from one named Franklin Process:

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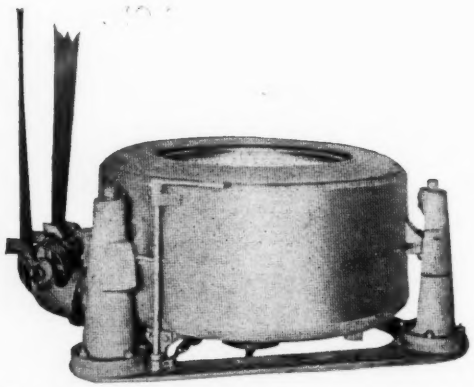

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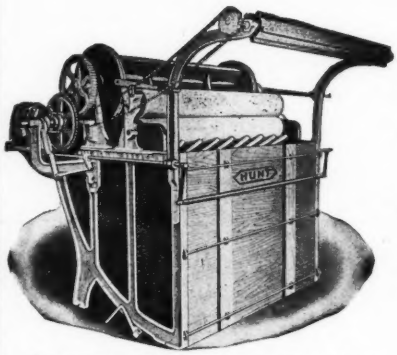

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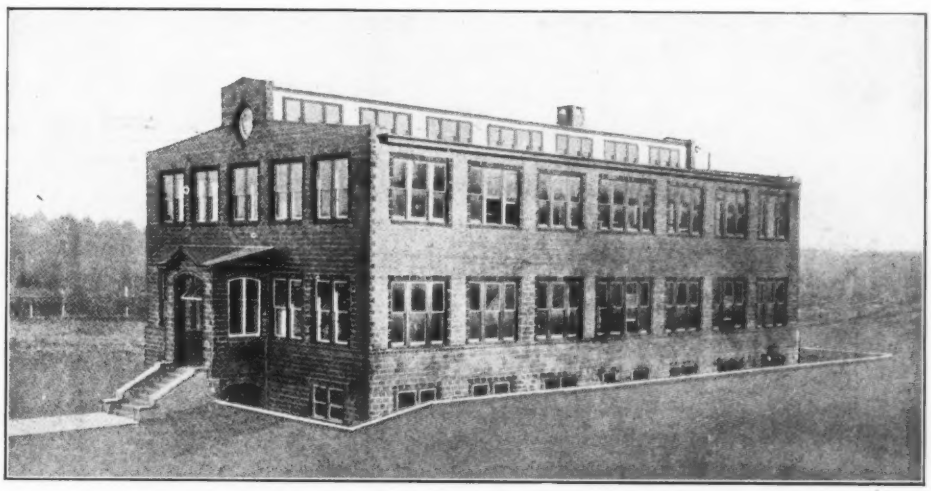

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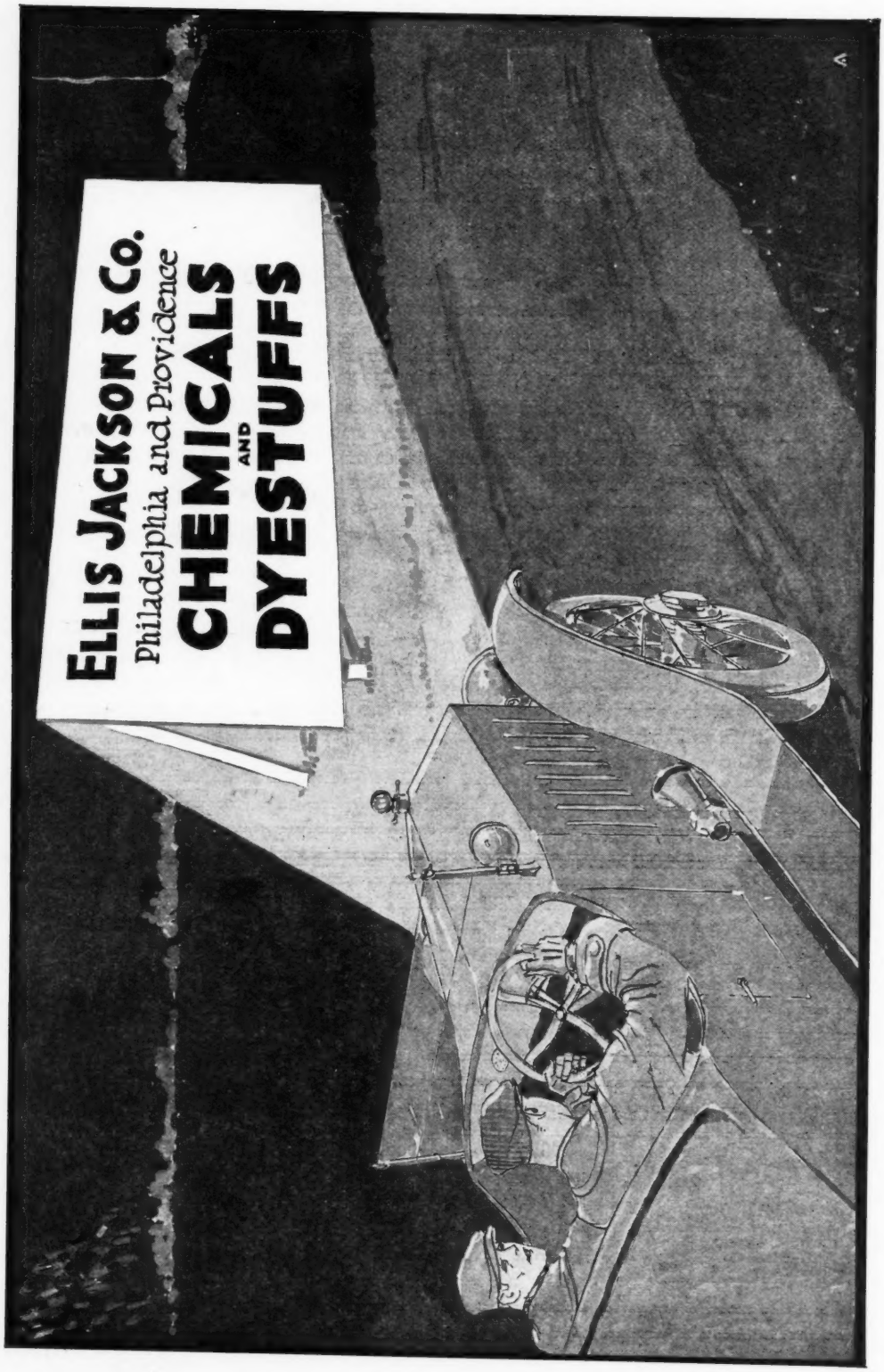
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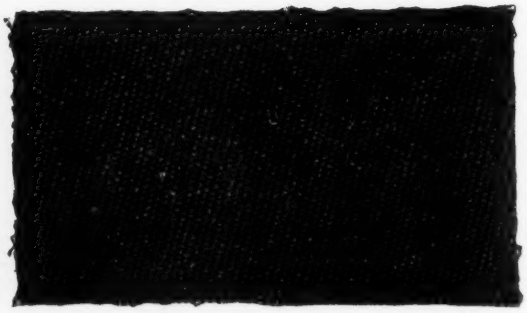

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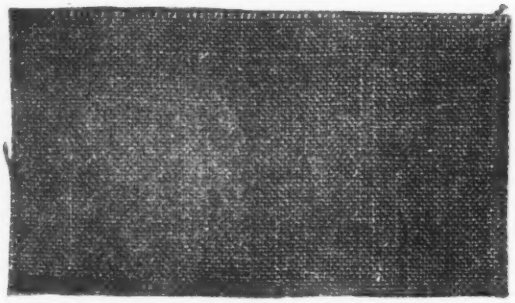

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VOLUME XI | NEW YORK, SEPTEMBER 11, 1922 | NUMBER 6

A Quarter Century of Technical Education in Textile Chemistry and Dyeing

Professor Hummel: A Pioneer and His Works—Society of Dyers and Colourists—Textile Chemistry and Dyeing at Lowell Textile School; Early History—Distinction Between Trade and Technical Schools —Relative Value—Versatility of Present-Day Technical Training—Attitude of Manufacturers and Dyers—Technical Education No Longer an Experiment—The A. A. T. C. C.— Development of Research Work

By LOUIS A. OLNEY

Note—This article is written at the request of the publisher of The AMERICAN DYESTUFF REPORTER *by Professor Olney upon his completion of twenty-five years of continuous service as head of the Department of Textile Chemistry and Dyeing at the Lowell Textile School. One by one Professor Olney's associates and contemporaries in other institutions have left the ranks of education for the more lucrative posts connected with manufacture, distribution and application of dyestuffs, but he has always felt that he could render a greater service by remaining in the educational field. He has thus come to play an important part in the education and training of many of the leading textile chemists and colorists in the country to-day, and may well be styled the Dean of Education in the field of textile chemistry and dyeing.—A. P. H.*

AS a world-wide proposition, technical education in the field of textile chemistry and dyeing has developed during the last forty years, but in America its growth has taken place more particularly during the past quarter century.

PROFESSOR J. J. HUMMEL AND TEXTILE CHEMICAL EDUCATION IN ENGLAND

In England Professor J. J. Hummel will always be looked upon as the real pioneer of technical education in textile chemistry and dyeing. He took charge of the Dyeing Department of Yorkshire College at Leeds upon its inception in 1879, which position he held until his death in 1902.

His original working outfit consisted of a building little better than a shed, with the crudest type of equipment; but from this small beginning there developed as early as 1885 an excellent group of buildings for his department, and these were materially enlarged in 1899.

His textbook entitled The Dyeing of Textile Fabrics was for a number of years the only publication in the English language of any great value to students of this subject. This book was later translated into the German, French, Italian and Japanese languages, and is truly entitled to the position of a classic in the literature of textile chemistry and dyeing.

The practical value of education of this type was thoroughly demonstrated by Hummel, and within a comparatively short time other English educational institutions established similar departments and courses which have, in a number of instances, developed into schools of prominence such as those at Bradford and Manchester, with a large number of such courses in smaller institutions throughout England and Scotland.

THE SOCIETY OF DYERS AND COLOURISTS

The Society of Dyers and Colourists has also played an important part in the development of textile chemistry and dyeing in England, and for many years it has not only provided an excellent medium for the publication and exchange of new ideas, but has encouraged a high standard of research work and in general greatly stimulated the development of education in this field.

Establishment of the Department of Textile Chemistry and Dyeing at the Philadelphia Textile School

As early as 1887 a Department of Textile Chemistry and Dyeing was added to the Philadelphia School, and later, under the able guidance of J. Merritt Matthews, became an important factor in this branch of education, and the standard set by Dr. Matthews has been well maintained by his successors.

Early History of the Lowell Textile School and Its Department of Textile Chemistry and Dyeing

The writer's knowledge in regard to textile education has come very largely through his association during the past twenty-five years with the Lowell Textile School, and the experience gained through association and council with no less than sixty different assistant professors and instructors who have faithfully served for varying periods of time in his department. Intimate contact with several hundred students, many of whom are to-day holding leading positions of responsibility in the dyestuff and textile coloring industries, has also played an important part in the shaping of his views on many points. For these reasons it will be difficult to write adequately upon this subject without introducing, to some extent, the various experiences of the author, and without occasionally imparting to some of the statements an almost autobiographic character.

The first legal steps towards the incorporation of the Lowell Textile School were taken in 1895, although the move to establish such a school dates back to 1891. It was not until early in 1897, however, that its doors were regularly opened to students.

Largely through the influence of Thomas Walsh, Superintendent of the Hamilton Print Works, one of the original trustees of the school and an ardent supporter of its activities until his death a few years later, the Chemistry and Dyeing Department was given an impetus at the start which might otherwise have been delayed some years. Through his persistence, in the face of many obstacles, this department was organized on an adequate basis and opened in the fall of 1897.

The rather immature and inexperienced young man engaged to organize the work of this newly established department was somewhat nonplused when, during the latter part of June, 1897, he was ushered into a large room the only redeeming feature of which was its expanse—a serious fire a few weeks before having destroyed most of the floor and some of the ceiling—and was told that this was to be the location of the laboratory and dyehouse and that it must be ready for use early in September.

Encouraged by the whole-hearted support of Mr. Walsh, plans were immediately formulated and active measures initiated looking to the contsruction and equipping of a laboratory. It was considered something of a joke on the part of some of the trustees when it was suggested that desk room and equipment in the laboratory be provided for forty-eight students. One trustee in a humorous way wanted to know if the intention was to open with a university the first day, and the general feeling prevailed that if provision was made for twenty students it would be ample. We insistently held out for the forty-eight, however, and when the laboratory finally opened in the fall we had the great satisfaction of advising the skeptical ones that instead of empty laboratory desk room we had rather an embarassing overflow, since more than sixty students had registered for chemistry the first day.

At first, provisions were made for a three-year day course and an evening course extending through the same number of years. The evening course was comparatively short and elementary as compared with the day course, for the latter called for a total of thirty-one hundred and fifty hours of actual school work, while the former required only three hundred.

From the very beginning the idea of a high-grade technical school rather than a trade school was foremost in our minds, but during the early years of our existence it often required considerable diplomacy to maintain our convictions.

Trade School as Distinguished from Technical School, and Their Relative Value in the Textile Industry

The trade school has proved to be a valuable factor in the development of a number of industries, and, to a certain extent, the textile industry; but advocates of the trade school in connection with the textile industry have not always taken into consideration the following facts: First, that the educational requirements of all industries are not equally adaptable to the trade school idea; second, that all departments of the same industry may not profit to the same extent by this type of education; and third, that valuable as trade school education may be to any particular industry, technical education as applied to the same industry may be equally valuable and much more effective in its development.

In this connection it may be said that the conception of the general public as to what constitutes a trade school is quite varied. In the minds of some, any school that teaches something of value to any particular industry is a trade school. In accordance with this interpretation, some of our highest grade technical schools would be classed as trade schools. In the minds of others a trade school is an institution which actually teaches one to perform some more or less skilled manufacturing operation or craftsman work in order, as some put it, that the student may be able to secure a job without going through a long apprenticeship.

The real trade school, in truth, lies somewhere between these two conceptions. In many instances admission may

be obtained directly upon graduation from the grammar school, and while in most instances the student specializes upon some more or less skilled occupation, he is taught, at least in an elementary way, such subjects of a scientific and mechanical nature as will be of assistance to him in the more intelligent grasping of the general principles involved in the special industry or trade that he is studying.

As applied to the textile industry a pure and simple trade school would teach prospective operatives to card, spin and weave, and would not graduate them until they were competent to accept positions in the mills. In the same manner a trade school would supposedly teach those who wished to dye and finish cloth, but this undertaking immediately involves complications that do not arise in the first instance. Carding, spinning and weaving are largely mechanical operations, for if the card mule and loom are in the proper condition the process goes on more or less automatically, the chief function of the operative being to see that the raw material is properly added and the manufactured material carefully removed from the machine, and also to correct any irregularities of the process which may occur through breakage of the yarn or other disturbance of the stock.

In the dyeing and finishing operations, on the other hand, the mechanical treatment is only one of many considerations. There is also involved the proper choice of dyes and chemicals, decision as to the length of time necessary properly to carry out the operation, proper temperature to use, and sufficient knowledge and experience to know when the operation should cease. Furthermore, the whole series of operations and treatments may be entirely different one day from those of the day before, and must often be completely changed upon short notice to suit different types of material. Another serious difficulty which would arise in the case of a trade school for dyeing and finishing would be the expense of the stock and material used. The yarns and undyed cloth that might be manufactured could easily be of a more or less staple type, and could readily be disposed of, at least at such prices as would cover the cost of the raw stock; but the smallest possible attempt at a dyeing and finishing plant, if equipped on the same scale as the manufacturing departments of such a school, could put through in a week or two all the material the remainder of the school could manufacture in a year, and any attempt to give a thorough training on full size machines would involve so many kinds of material, and result in so much expense, as to be prohibitive.

For the prospective bleacher, dyer, printer and finisher the technical school training appears to be far more practical and valuable. A thorough technical training involving chemistry, physics and mathematics, with a study of the composition and properties of the fibers, dyes, chemicals and other materials used, will accomplish more toward developing an efficient and intelligent dyer and finisher than an indefinite time blindly spent over a dye tub or scouring machine.

A technical training of this type coupled with much laboratory work and such practical experience as can be derived from the full size machines of a well equipped school, especially if the student has spent several of his summer vacations in a mill dyehouse or finishing plant, is far in advance of anything that could possibly be accomplished educationally in the pure and simple trade school of dyeing and finishing.

Versatility of Technical Training in Textile Chemistry and Dyeing

Another great advantage of technical training is its versatility, the possessor being equally equipped to enter the field of cotton, wool or silk dyeing, textile printing, finishing, and also the various branches of dyestuff manufacture and distribution. This fact is substantiated by the following tabulation of one hundred and twenty-four living graduates from such a course at the Lowell Textile School:

Group A—Strictly Textile—	
Dyeing and finishing	28
Textile mill chemists	12
Print works superintendents and overseers	6
Felt manufacture	2
Hosiery manufacture	2
Manager of cotton mill	1
Manager of woolen mill	1
Manager of silk mill	1
Government chemist	1
	54
Group B—Dyestuff Field—	
Managers and salesmen of dyestuff concerns	20
Dye manufacturing chemists	16
Chemists and technical men (dyestuff distribution)	7
	33
Group C—Miscellaneous—	
Superintendents and chemists of rubber works	7
Teaching	5
Leather chemists	2
Gas works chemists and superintendents	2
Glazed paper	1
Pharmacist	1
Bacteriologist	1
Manufacture of typewriter ribbons	1
Occupation at present unknown	7
	27

An analysis of the above tabulation shows that the dye industry draws almost as heavily upon the graduates of such a course as the textile industry. Group C is a natural sequence of a thorough technical course in textile

chemistry and dyeing for these reasons: The fundamentals of the science of chemistry are the same whether applied to textiles, dyes, rubber, leather, gas manufacture or any other industry, and furthermore the chemical requirements of the textile and dyestuff industries are so extremely broad and varied that in many respects they cover the other industries almost as well. As a result, a reasonable amount of additional specialized study will develop a leather, rubber, gas or paper chemist as well as a general industrial chemist or chemical engineer.

In the development of such a course the cultural studies should not be overlooked. English, at least one foreign language, economics, and industrial history, should be introduced. The reason for this is self-evident. Every student, if he is made of the proper material, hopes at some future time to be the manager of the enterprise with which he may become identified, and in these days no one can become an efficient and outstanding executive who neglects this side of his education. In this connection it might not be out of place to note that of the one hundred and twenty-four graduates tabulated above, over 25 per cent are already managers or chief executives.

Evening Courses, Lowell Textile School

Up to this point in our discussion we have had in mind almost wholly the day courses in textile training. The evening school, in its special field, however, has been no less important than the day school in the development of a particular type of education which must necessarily show differences since the possibilities and requirements are so different. A very large proportion of the applicants for admission to the evening courses have not gone further than the grammar school, although in recent years the number of high school graduates has increased and a varying number of college graduates register for some of the courses.

Most of the evening students are engaged in actual textile work during the day, and one of their chief objects in coming at night is to learn all they can in regard to the scientific and technical side of the particular work in which they are engaged in order that they may more understandingly perform their duties. The ambition for merited promotion on the part of their employers has also been no small impelling force in sending them to a hard evening's work after they have been busy all day. That their labors have been rewarded is evidenced by the large number that have risen to positions of importance, largely through their untiring efforts during a period of five years.

The evening courses in Textile Chemistry and Dyeing at the Lowell Textile School have been so planned as to give, in the limited time available, such subjects and laboratory work as will be of greatest value to the average student. When the day course was increased from three to four years, the evening work in Textile Chemistry and Dyeing was lengthened from three to five years. This was accomplished by increasing the work in Elementary Chemistry from one to two years and recognizing it as a separate course, and extending the special work in Textile Chemistry and Dyeing from two to three years, thus making, in all, five years of continuous work. A special three-year course in analytical chemistry was introduced at the same time.

The limitation of possibilities of the evening work already referred to will be made clearer if we consider this fact. Allowing the greatest possible number of hours for evening work, it would require more than thirty years for an evening student to take the same studies covered by the day student in the four-year day course. While the evening work is necessarily simplified somewhat the quality has been maintained at a high standard in the belief that any attempt to adapt it to all would greatly reduce its value for the majority. Although the mortality, so to speak, has been high among the day students, it has been much higher among the attendants at evening school; scarcely 10 per cent of those entering the Chemistry Department are ever graduated from the full five years' work. This is not due wholly to lack of interest or inability to keep up with the work, but partly to the fact that the evening school students are to a considerable extent transient, living in Lowell or Lawrence a year or two and then moving to some other city. It has been noted in many cases, however, that young men come from great distances to work in the mills of Lowell or Lawrence in order that they may attend the evening school.

Attitude of Manufacturers and Dyers Toward Technical Education

One of the most interesting and gratifying developments of the past twenty-five years has been the gradual change of attitude on the part of manufacturers and the older type of self-educated dyers and colorists toward technical education in Textile Chemistry and Dyeing. Many manufacturers at first were skeptical as to its value, and were inclined to believe that a man who had enjoyed four years of practical experience in their mill, under their supervision, would be of greater value to them than one with four years of training in a school. We will grant that this is very likely to be true during the first week, and perhaps the first month or maybe the first year, but observation has demonstrated time and time again that it actually works out about as follows: Assume that of two young men possessing as nearly as possible the same intelligence, capability, and preliminary education, one enters a textile establishment and the other a textile school of recognized standing. At the end of four years intensive training in Textile Chemistry and Dyeing the latter graduates from the school and enters the same

establishment at which the former has been employed for four years. During the first month, or perhaps the first year, the former may be of far greater value to the mill than the latter, but observation has shown that in a large proportion of such cases the textile school graduate has risen to a position where he is issuing orders to the other, and that within ten years after the time both graduated from high school he has outstripped the other as to ability, grade of position and salary. Manufacturers have also been keen enough to observe this fact, and to-day a very large proportion of them give preference to textile school graduates whenever there is an opportunity to take on young men.

As to the older type of practical dyer, he looked on at first with a mingled feeling of skepticism and uneasiness; but before many years had passed these same men were sending their sons to the day textile school and attending the evening school themselves. To-day the textile school influence has so permeated the dyeing industry that it is the exception rather than the rule to find a dyer who is not interested in textile school education either because he himself has attended or because some relative or friend has profited by it.

Practical Experience as a Requirement

Earlier in this article reference was made to the advisability of day students spending at least part of their summer vacations in textile coloring plants, bleacheries or finishing establishments. The value of this has been so well demonstrated that there is every reason to believe that as time goes on it will become one of the requirements that a candidate for the degree of Bachelor of Textile Chemistry shall have had a minimum of six months' practical experience in one or more branches of textile coloring, with a certificate from his employer as to the character and quality of his work.

Some manufacturers are still loath to take in students for short periods, particularly in dyeing and finishing, but the number is growing smaller all the time. The progressive and broad-minded ones have long since come to the conclusion that they themselves might benefit in several ways. As crude and immature as these student helpers may be, in many instances they make suggestions of value to the dyer and not infrequently leave as much of value as they take away. Furthermore, the average employer of men in the textile coloring branch of the industry realizes the difficulty in securing good men for this kind of work, and realizes that unless he contributes his share towards their training and development he is making the situation just so much worse. Employers also have found it of great value to get a line on some of these young men during the early years of their schooling in order that they may be able to select satisfactory ones upon their graduation. Manufacturers cannot be advised too highly to give this phase of textile education their careful thought and consideration.

Technical Education No Longer an Experiment as Far as the Textile Coloring Industry Is Concerned

Technical education as applied to the textile industry is no longer an experiment, and this is particularly true in relation to the bleaching, dyeing and finishing departments. As far as the writer knows, the textile schools at Philadelphia and Lowell were the only ones which existed in the United States twenty-five years ago, but since that time the wisdom of those who made these two schools possible has been sustained and the value of the institutions demonstrated by the fact that in more recent years textile schools have been established in many of the American textile centers, both in the North and South, and, while these may vary more or less in completeness and standards of instruction given, they are all undoubtedly doing much towards the development of the textile industry, and are increasing its ability to compete with that of other nations. There seems to be no doubt but what the establisnment of technical textile schools in Germany many years before they were even thought of in this country was an important factor in the development not only of that nation's textile industry in general, but of the dyeing, printing and finishing industries in particular.

American Association of Textile Chemists and Colorists

It is hoped that as time goes on the newly formed Association of Textile Chemists and Colorists will become as important a factor in the educational development of textile chemistry and dyeing in America as the Society of Dyers and Colourists is in England. Less than a year old, the former organization already has approximately 400 active members, and local sections have already been formed in Providence, Boston, New York and Philadelphia. The spirit of enthusiasm and co-operation, if well maintained by the members of this organization, will do much to supplement and support the technical educational system as applied to textile coloring and allied industries.

Development of Research Work

In closing, a word should be said in regard to what will probably prove to be the most important development of the next quarter century in the field of textile chemistry and coloring, namely, research work in textile chemistry and the application of dyes. A con-

sideration of this development is important in this connection, since it will result largely as a development of the educational activities that have taken place along this same line during the past twenty-five years.

The time is coming, and is not far distant, when the necessity of greater activity along this line will overbalance the spirit of timidity, procrastination and unwillingness to finance, now so prevalent on the part of textile manufacturers and textile manufacturing associations in regard to the promotion of research work in this field. In this respect the American manufacturers may well profit by the foresightedness and activity of some of their foreign competitors.

Research as applied to textile chemistry and dyeing is a complete subject in itself and one which the author hopes to discuss more fully in another article at an early date.

AUTHOR'S NOTE

Since completing the foregoing article my attention has been called by an alumnus of the Lowell Textile School to an editorial entitled The Textile Chemist, which appeared in the August number of a contemporary publication, and also to a similar editorial which was printed in the same journal some months previous.

Both of these editorials infer rather emphatically that nowhere in the United States is there to be found an educational institution, of college grade, giving instruction in textile chemistry; and furthermore, that no such institution is represented by a competent instructing staff of high scholarship and scientific attainment.

While some of the points emphasized by the writer of these editorials are, unfortunately, too true; particularly those referring to a general lack of interest in technical education on the part of the textile industry; he appears, nevertheless, to be either misinformed or ill advised in regard to the first mentioned condition.

In justice to the Lowell Textile School as an institution, to its instructing staff in the Department of Chemistry and Dyeing, and to its alumni and student bodies, I take exception to these editorials.

Omitting entirely from our consideration the head of the above department, let it be said that it possesses eight other professors and instructors, all of whom possess scientific degrees from institutions of recognized standing, and that two of these hold doctor's degrees. Of the eight, six have had considerable experience and training along research lines.

The requirements for admission to the course in Textile Chemistry and Dyeing as given at the Lowell Textile School are the standard requirements quite generally adopted at the higher grade colleges and technical schools. The course itself requires four years, and grants to those who successfully complete it a bachelor's degree, by permission of the Massachusetts Legislature upon recommendation of the State Board of Education.

Before graduation each student must present a satisfactory thesis upon some piece of research work or special investigation extending over a full year's time.

In the last few years there have been presented more than one hundred such theses, which, for the most part, represent original work. For various reasons it has not been the policy of the institution to publish them, although they are all on file at the Lowell Textile School and are open to the inspection of anyone who appears to have a legitimate reason for examining them.

During the past five years a considerable number of the students in the Department of Chemistry and Dyeing have either been graduates of, or have attended for several years, some of our leading colleges and technical schools.

The number applying for post-graduate work is constantly increasing, and plans are already being considered which will encourage further graduate work and develop it to a still higher standard of scholarship and efficiency.

For a number of years the United States Government, through its various departments and bureaus, has given the Lowell Textile School a rating with other colleges and technical schools of the country.

The author does not wish to express a personal opinion.

He simply leaves it to those who have been sufficiently interested to read the above facts to draw their own conclusions.—L. A. O.

ACCURACY IN COLOR MATCHING

By W. E. Forsythe

The color temperature of an incandescent source has been defined as the temperature at which it is necessary to operate a black body so that the color of the integral light from the black body is the same as that from the source being studied. Since the light from all radiating substances cannot be accurately matched in color with that of a black body at a particular temperature, it is more accurate to define the color temperature as that temperature of a black body at which the ratio of the radiant flux at some two arbitrarily chosen wave lengths is the same as that for the radiating substance being investigated.

In general, color-temperature meaurements can be quite accurately made with an ordinary Lummer-Brodhun contrast photometer. The process of determining such temperatures is known as color matching.

Two tests have been made of the accuracy of color matching with an ordinary Lummer-Brodhun contrast photometer.

(*Concluded on page* 207.)

Carbonizing Raw Wool and Noils by the Sulphuric Acid and Aluminum Chloride Processes

Great Care Necessary to Avoid Injury to Stock—Scouring the Stock—Carbonizing Reagent Treatment—Carbonizing Reagent Strength—Drying and Carbonizing the Stock—Dusting

By A CONSULTING TEXTILE CHEMIST

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Of the many processes through which wool passes after leaving the sheep until it appears in the finished article, the process known as "carbonizing" is perhaps the most interesting to the chemist. It is in this process that there is the greatest chance for permanent injury to the stock during processing, and therefore it is here that the chemist is able to be of greatest value by properly controlling the variable factors of the different operations of carbonizing.

Wool, as it comes from the sheep, contains wool wax, or "wool grease" as it is called; suint, dirt, manure, and more or less vegetable matter such as burs, seeds, straw, shives, etc. Pulled wools also contain lime, sulphides, etc. The scouring operation with its prior opening of the stock and mechanical operations serves to remove a certain amount of this vegetable matter, depending a great deal upon the character of the vegetable matter and the stock itself.

Carding and combing each serve to remove further quantities of this vegetable matter, but in many cases it is of such character that it is impossible to remove it completely by any mechanical process without serious injury to the stock. If this vegetable matter is allowed to remain in the wool in quantity it will cause much trouble in the succeeding operations, and if excessive, may even render certain operations impossible. Even relatively small amounts of vegetable matter may cause much trouble in dyeing the finished materials.

The vegetable matter not removed by the scouring operation or by the bur picker is most successfully removed from the wool when it is in the raw or loose condition, by the carbonizing process. The word "carbonizing" is defined in some dictionaries as "the process of converting into carbon," and this is what appears to be done to the vegetable matter in the wool stock. What actually happens is that the vegetable matter is converted into hydrocellulose by the sulphuric or hydrochloric acid of the carbonizing reagent solution. This hydrocellulose has somewhat the appearance of charcoal, i. e., it appears as if the vegetable matter were in a charred or "carbonized" condition. It is very brittle, easily powdered, readily dusts out of the wool stock. When the carbonizing is properly done the wool stock remains uninjured, but there is possibly no other operation in the manufacture of woolen materials where there is so much chance for injury to the stock through ignorance or neglect of the conditions.

While it is possible to remove the vegetable matter by carbonizing "in the piece," i. e., in the finished cloth, it is much more liable to cause trouble due to defects and spots in the fabric. Also, if the goods are carbonized in the piece after dyeing, only a limited number of dyes may be used, as not all dyes are fast to carbonizing. Further, many wool stocks contain so much vegetable matter—and this of such a character—that it is impossible to make a satisfactory yarn from the stock without the removal of the vegetable matter. Defects in the finished materials will never be due to carbonizing if it is properly done on

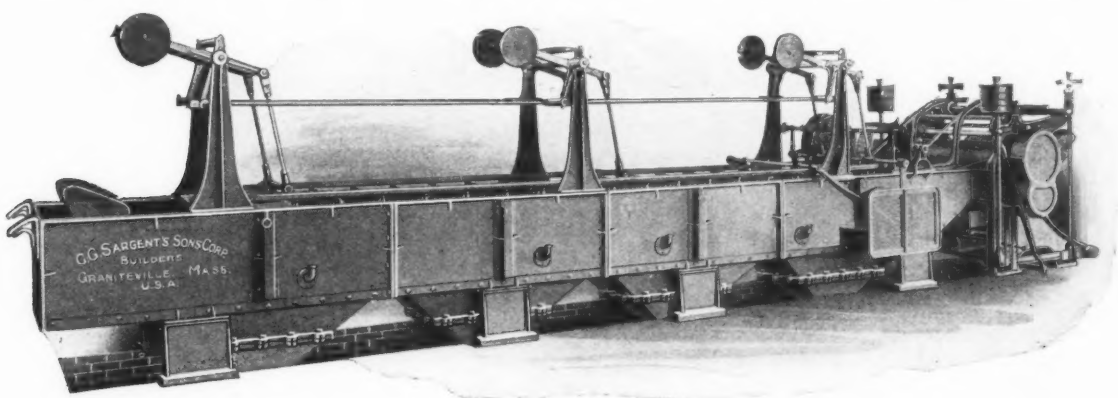


Fig. 1—*Single Bowl of Scouring Machine, with Squeeze Rolls. C. G. Sargent's Sons Corporation*

the raw stock and the succeeding operations have not been at fault.

Practically all carbonizing of raw stock and noils is now done by means of sulphuric acid or aluminum chloride solutions of suitable strength. Niter cake refuse from the manufacture of acid has been very successfully used as a cheaper substitute for sulphuric acid at some plants. When used for this purpose it should be free from nitric acid. Hydrochloric acid gas is coming into a wider use recently for carbonizing shoddy and rags, but it is not used at present upon raw wool and noils. As the process using niter cake is identical with that for sulphuric acid, which is really the active constituent of the bath, I will not differentiate between the methods for these reagents. As the hydrochloric acid gas or "dry carbonizing" method is used only for shoddy, etc., I will not cover it in connection with raw stock carbonizing.

Magnesium chloride has been used to a slight extent as a carbonizing reagent, but apparently without much success, as it is not in use at present. Its action is somewhat similar to that of aluminum chloride, except that it leaves the stock in a slightly alkaline condition after carbonization. The dissociation temperature of the magnesium chloride is slightly higher than that of aluminum chloride, and it is claimed that this higher carbonization temperature, with a consequent discoloration of the stock, is the reason the use of magnesium chloride has not become more popular.

A great majority of the carbonizing is on noils and a small proportion is upon grease stock. There is also some carbonizing of union waste, containing wool or silk and cotton, but this work is handled in the same manner as noils and will not be treated separately. Where grease stock is to be carbonized the stock is usually first scoured sufficiently to allow the acid reagent solution to thoroughly saturate the stock.

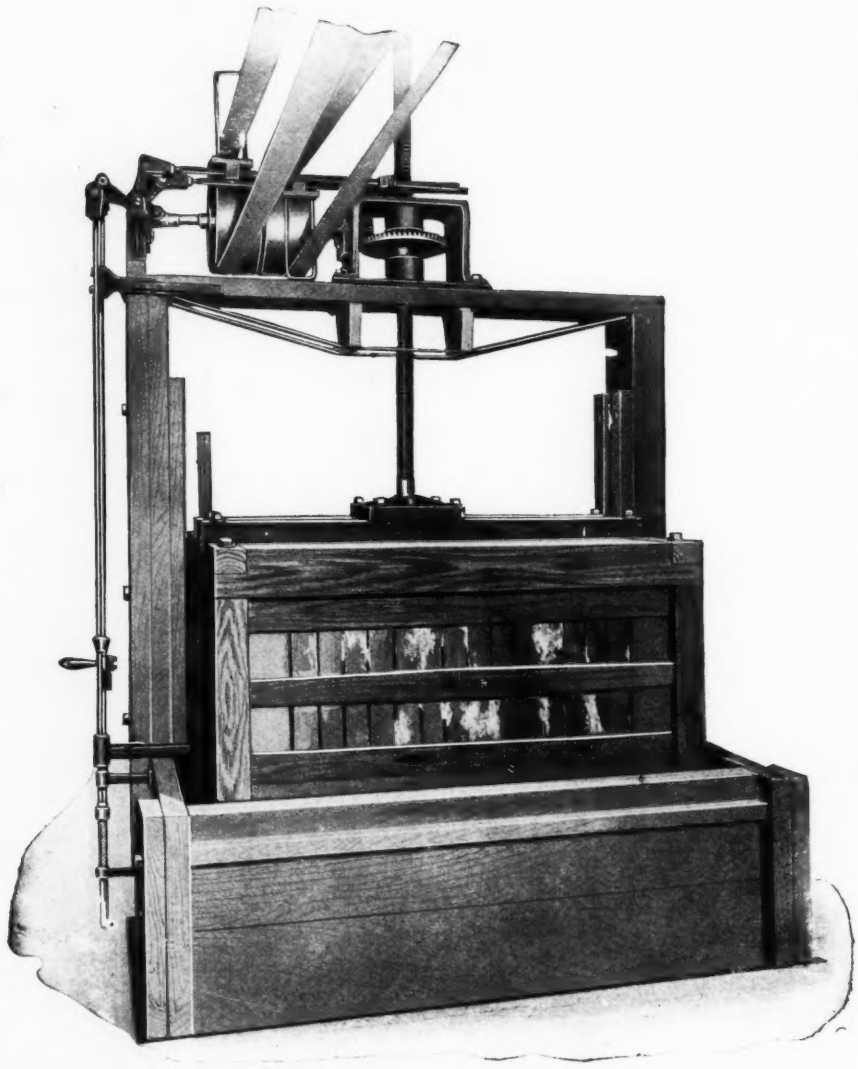


FIG 2—*Screw Acid Tank with Wooden Cage for Loose Raw Wool or Noils. C. G. Sargent's Sons Corporation*

The aluminum chloride process of carbonizing is coming into rather wide use in America at the present for certain classes of stock, but as far as the writer has been able to ascertain, it is used very little in England and Europe, and not at all in Australia and South America. It is a question just why it has not found more favor in these foreign countries, except that the process is considerably harder to handle successfully, and it is far more expensive to operate than the sulphuric acid process. However, the better results appear to justify the increased cost in most instances. In the United States a great deal of carbonizing is done by the aluminum chloride process, several large concerns specializing on this particular process and handling it very successfully. Smaller, inexperienced concerns appear to have considerable difficulty with the process.

In order to secure the desired result in the aluminum chloride process of carbonizing, the entire operation should be controlled by the chemist from laboratory analyses, etc. It is only by this means that the best results can be uniformly obtained. It is absolutely impossible to depend upon the judg-

FIG. 3—*Lead or Rubber Lined Hydro-extractor for Removal of the Excess Carbonizing Reagent. Tolhurst Machine Works*

ment of the average mill employee to cover all the variables of the procedure, and the only way to positively know what is taking place in each operation is by means of chemical control. While it is, of course, desirable to have chemical control of the sulphuric acid method of carbonizing, it is not nearly as essential, and I believe it is only so controlled in a few plants in this country.

The actual carbonizing process takes place in three principal stages: First, the wetting out or scouring, as the case may be; second, the impregnating with the carbonizing reagent, and third, the drying and actual carbonization or baking. Generally, but not always, a process of dusting follows this third stage, wherein the hydrocellulose is removed from the stock in dusters. Later the stock may be rinsed or neutralized, but this is a separate operation.

SCOURING THE STOCK

The first or scouring stage of the operation may consist of anything from a hard four or five bowl scour, in the case of a very greasy, hard scouring wool, to simply passing through a single bowl of water at, say, 75 deg. Fahr. in the case of a fairly clean noil or scoured wool.

In carbonizing, as in scouring, the result desired, as well as the stock handled, generally varies greatly in different lots. Where a light shrinkage of the stock is particularly desired the scouring and wetting-out of the stock must be reduced to a minimum, so as to remove as little as possible of the non-vegetable foreign matter contained in the wool, and yet obtain complete removal of all vegetable matter. Where a manufacturer is carbonizing his own stock, the result desired and the kind of stock handled are often fairly uniform at all times and a standardized scouring procedure may be adhered to in all cases.

In this country it is usually considered necessary in both sulphuric and aluminum chloride processes to at least have the stock scoured sufficiently to allow it to be thoroughly saturated by the carbonizing reagent. In the case of noils, it is highly advisable to remove all mineral or other oils which might prevent the reagent from saturating every part of both the animal and vegetable matter.

In most cases the scouring operation is conducted in the same manner and with the same machinery as in the regular scouring of raw wool. Just how hard the stock is scoured in many cases depends a great deal upon the judgment of the washerman. Some men scour raw stock to be carbonized harder than the regular scour; others do not scour so hard. On noils, the strength of the scour will vary widely also, as the kind and amount of oil present will materially alter the scouring conditions and requirements. The loose stock, either raw or noils, is usually scoured in the regular type of scouring machine, such as shown in *Fig.* 1. The scouring details given by Prof. Olney in his papers upon "Operations Preliminary to Dyeing Wool Fiber," published in this journal in 1921, may well be applied to scouring loose stock for carbonizing.

In Europe, especially in Germany, some plants carbonize the wool in the grease, i. e., before scouring, by

FIG. 4—*Hercules Electric Extractor. East Jersey Pipe Company*

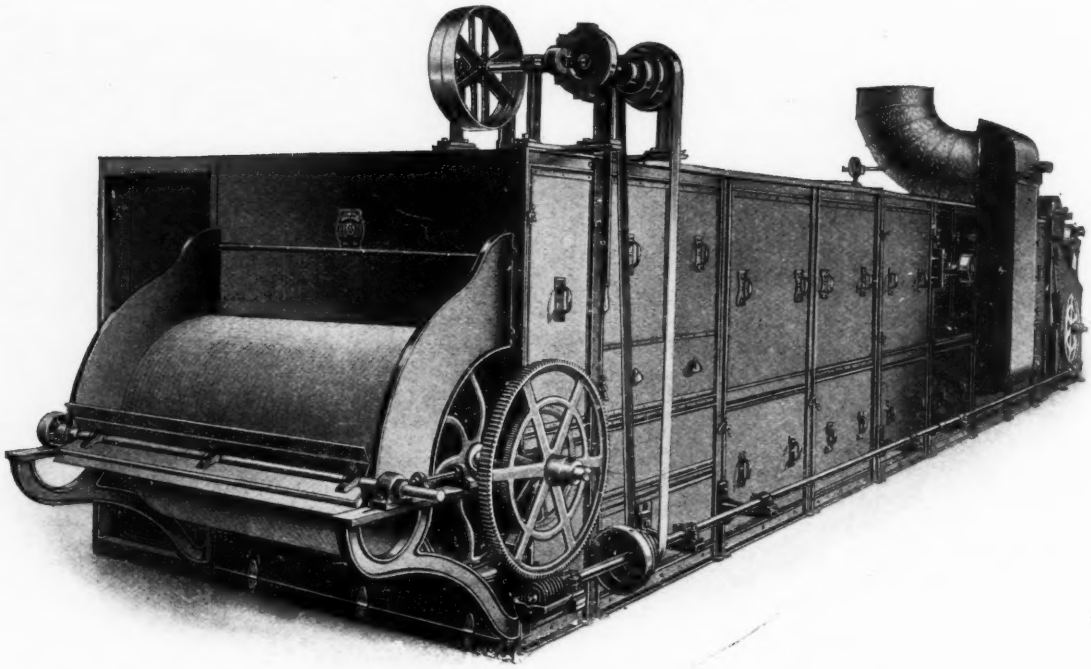


FIG. 5—*Single Apron Type of Dryer Sometimes Used in Carbonizing. C. C. Sargent's Sons Corporation*

means of sulphuric acid. While there are some claims as to the advantages of this carbonizing in the grease, from the writer's experiments these so-called advantages do not work out well. The claim is made that the grease protects the stock from the acid, but the grease also protects the vegetable matter to some extent, thus requiring a stronger solution of acid to be used, and it is very possible that the action of this stronger acid on the stock is just as severe as a weaker solution upon the scoured stock.

In the drying and carbonization of the grease carbonized stock, the grease is baked into the stock. In many instances this baked-in grease tends to permanently discolor the stock to some extent and in any event it requires a considerably harder scour in order to complete its removal. Then, too, before the actual scouring of the carbonized stock can take place, the acid remaining from the carbonizing must be neutralized. When the stock is to be acid dyed as loose stock, this neutralization is often entirely unnecessary and a needless expense.

Also in carbonizing grease stock, the acid very soon becomes too dirty for use, and unless the stock is at least first steeped or rinsed to remove the alkali originally in the stock and suint, this alkali very materially reduces the acid's usefulness, thus increasing acid costs. Furthermore, the loss of this original alkali of the wool to the scouring process requires an additional use of alkali in the scouring, thus again slightly increasing the scouring cost.

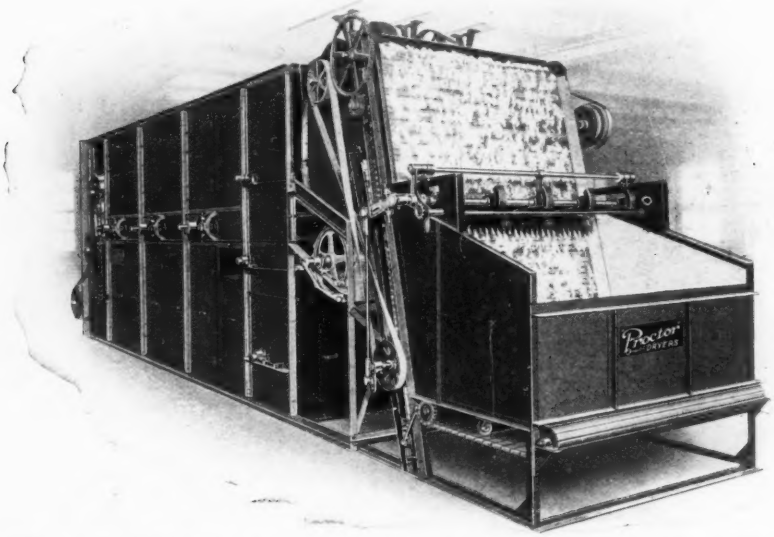


FIG. 6—*Feed End of a Three Apron Dryer of the Type Used for Carbonizing. Proctor & Schwartz*

However, in spite of these many apparent disadvantages of carbonizing in the grease, H. Hey (Journal Society Dyers and Colourists, Vol. 37, page 82), recommends it in connection with solvent scouring: "There was a large and increasing quantity of wool used, particularly Cape wool, which contained much vegetable matter, seeds and burs, contracted from the pas-

turage. This was removed by steeping the wool in acid and subsequently drying. By this treatment the vegetable matter is carbonized and reduced to a powdery condition and is readily removed. Unless the process is very carefully controlled the wool is also affected to some extent, and even under the best conditions its quality cannot be said to be improved. If the wool is carbonized in the greasy condition and then immediately solvent scoured before washing, a cleaner and better result is obtained than when the wool is scoured before carbonizing." The author does not know of any plants in this country where carbonizing is done in the grease.

The wet scoured stock is sometimes dried before entering it in the acid reagent tank or bowl. This previous drying allows the stock to absorb more reagent and prevents dilution of the reagent by the water which would be in the wet stock. This drying is an expensive procedure and, as many plants operate successfully on the wet stock, without any attempt to dry it, the extra expense is hardly justified. In fact, some plants always wet-out even the cleanest stock before it enters the acid. The only advantage of entering the stock dry in the carbonizing reagent is that a more dilute solution of the reagent may be used, but, as more of it is taken up by stock, this makes no real difference in the end.

After scouring, or wetting-out, as the case may be, the excess of water or scouring liquor should be removed from the stock before it enters the reagent. This is usually done by passing the stock through a set of squeeze rolls, adjusted so as to leave between 30 and 35 per cent condition in the stock. It is then ready for the carbonizing reagent.

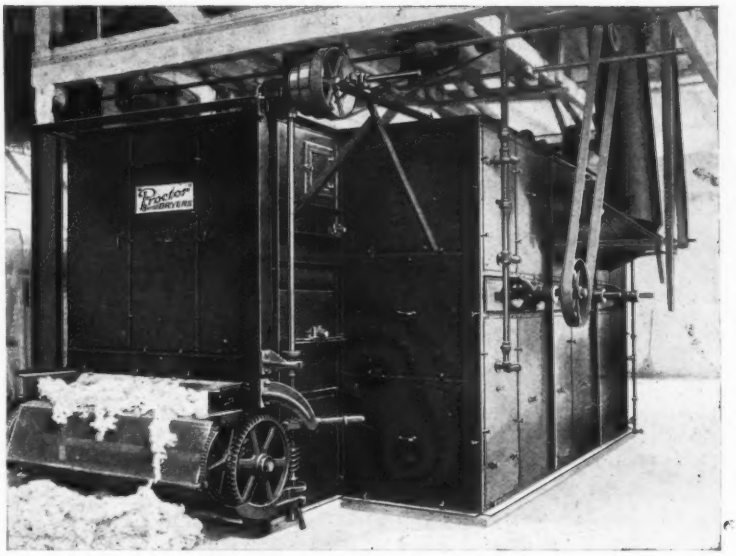


FIG. 7—*Rear End of the Three Apron Type of Dryer. Proctor & Schwartz*

CARBONIZING REAGENT TREATMENT

In order to insure thorough saturation of the stock, it should be completely opened out and well immersed in the reagent. For continuous operation the reagent is usually contained in tanks or bowls, arranged in such a way that the stock passes directly from the wetting-out stage, through the squeeze rolls, into the reagent.

The older method of saturating the stock with reagent in a tank is still used to some extent, where small lots are carbonized intermittently. In this process the scoured wool is usually placed in wooden cages, as shown in *Fig.* 2, which are immersed in wooden tanks of reagent for about one hour or more, sometimes as long as overnight. After the stock is thoroughly saturated with the reagent it is either passed through rubber squeeze rolls or a hydro-extractor to remove the excess reagent.

Figs. 3 and 4 show centrifugals suitable for this work. They are made with a lead-lined case and a basket of all bronze and copper coated with an alloy of about two-thirds lead and one-third tin; or with a rubber-lined case and an iron and steel basket coated on the inside and outside with hard rubber. While the lead-covered machines are suitable for sulphuric acid work, the rubber-covered machines are far more satisfactory for aluminum chloride and may also be used for sulphuric acid. These extractors are seldom used for handling large lots continuously, but are very useful for intermittent work on small lots.

In the case of sulphuric acid carbonizing, the reagent tank or bowl is constructed of iron, completely lined with lead in every part; or it

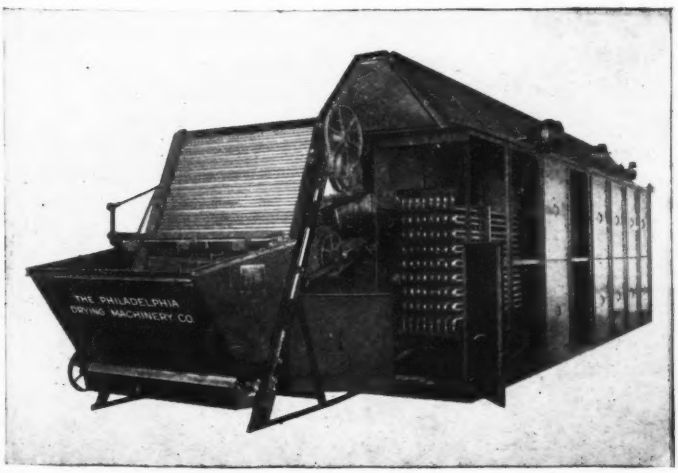


FIG. 8—*Showing the Construction of Carbonizing Dryers. Philadelphia Drying Machinery Company*

may be entirely built of cypress or pine wood. For aluminum chloride reagent, the tank must be of wood or rubber lined, as it attacks lead very rapidly. All iron parts should be kept out of either the acid or aluminum reagents, as it quickly discolors the stock.

In many cases, for continuous operation, the reagent tank is arranged similarly to a scouring bowl, with rakes and a ducker box, all of wood. The tank should be of such size and the speed so arranged that the stock remains in the reagent for about ten minutes, and all parts of the stock, both animal and vegetable, become thoroughly saturated with the reagent. While it is not necessary that the animal matter become saturated with the reagent in order to carbonize the vegetable matter, they are usually so matted together and closely associated that it is impossible to insure complete saturation of the vegetable matter without completely saturating all of the stock.

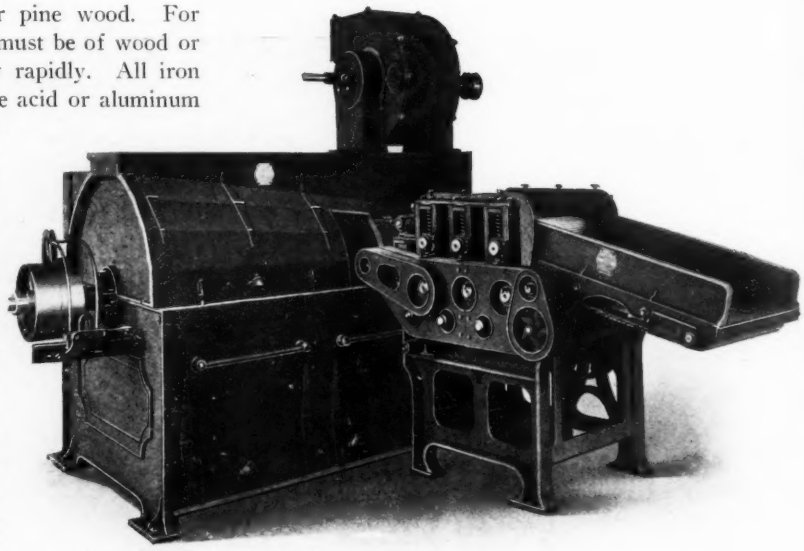


FIG. 9—*Carbonizing Duster with Corrugated Crush Rolls, Feed End. C. G. Sargent's Sons Corporation*

A set of squeeze rolls, entirely of rubber or wood, are arranged at the end of the reagent bowl, just as on a scouring machine bowl, and these are adjusted so as to leave about 40 per cent condition, or reagent, to remain in the stock as it goes to the dryers or carbonizers. After leaving the squeeze rolls of the reagent bowl, the stock is sometimes passed through a second reagent bowl and set of squeeze rolls before going to the carbonizer, in order to insure that every particle of the vegetable matter has received its acid treatment. This second treatment, however, is not necessary, provided that the first treatment was properly given.

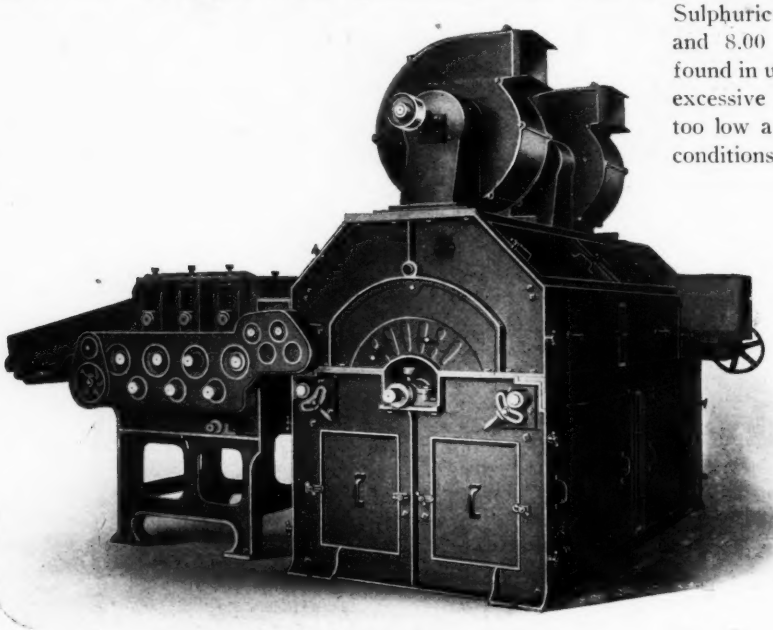


FIG. 10—*Larger Type of Carbonizing Duster. C. G. Sargent's Sons Corporation*

CARBONIZING REAGENT STRENGTH

A wide difference in opinion exists among carbonizing men as to just what strength of reagent is required for proper carbonizing. In practice the writer has found an even wider variation than that expressed by the men. Sulphuric acid strengths varying between 0.75 and 8.00 per cent actual H_2SO_4 have been found in use. Of course, this variation is rather excessive and, while no doubt 0.75 per cent is too low a figure to be safely used under most conditions, it is also true that 8.00 per cent is far higher than is ever needed and in most cases it will cause injury to the stock. A range of acid strengths from 3.00 to 6.00 per cent actual H_2SO_4, depending entirely upon the stock, amount, character and condition of the vegetable matter, and operating conditions, will satisfactorily handle all varieties of stock. It seems almost unnecessary to state here that the specific gravity or degrees Baume or Twaddell, as it is usually given, is absolutely useless in determining the actual amount of acid present in the solution,

(*Continued on page* 204.)

Centrifugal Extractors

An Outline of the Development of These Machines Together with a Description of Some of the Better-Known Types Now on the Market

By W. E. HADLEY and H. GRANDAGE

HYDRO-EXTRACTORS, as the name implies, originally had as their object the removal of water from some more or less solid form of material. The many different manufactured products containing liquids of various types, either acid, alkaline or neutral, as the case might be, which had to be removed during some stage of the manufacturing process, have resulted in the adaptation of hydro-extractors, or centrifugals, for the elimination of these liquids, so that at the present time the application of this type of machine is by no means confined to the rapid removal of moisture from textile material, but also finds a wide field of usefulness in the explosive and dyestuff sections of the chemical industry.

Hydro-extractors are used extensively in the textile industry for removing the excess liquor after the carbonizing treatment given woolen material. They find constant application in the laundry trade as well as in the dry-cleaning industry.

The diversified uses to which hydro-extractors have been applied have resulted in various modifications and adaptations of the machine, but the principle of the perforated basket, rapidly revolving in a horizontal direction around its center, remains the same.

Direct Motor-Driven "Center Slung" Centrifugal. Tolhurst Machine Works, Troy, N. Y.

Steam-Engine-Driven Extractors

The first hydro-extractors to attain commercial success were those driven by means of an individual upright steam engine.

Certain types of hydro-extractors were run by small steam engines with the piston directly attached to the shaft of the basket, the basket acting as the flywheel. The engine itself was supported on the side of the tub, care being taken that the basket was properly protected to prevent oil from entering the basket and coming in contact with the goods.

While the above types of machines have given very satisfactory results, there has always been more or less danger connected with their use owing to the liability of their being run at an excessive speed, brought about by the fact that the governors might be readjusted by incompetent help or, as sometimes happened, altogether removed, with a consequent speeding up of the machine away beyond the factor of safety.

If hydro-extractors, driven by individual steam engines, are to be used, the engine should bs of such size that the extractor can be driven with the minimum amount of steam pressure, which pressure should be controlled by a proper pressure regulating valve, so placed as to be out of reach of the operator.

Belt-Driven Hydro-Extractors

The next step in the utilization of hydro-extractors was the introduction of the belt-driven apparatus. This type of apparatus has enjoyed a long period of usefulness, and at the present time there are many such hydro-extractors in active use.

The Tolhurst Machine Works, Troy, N. Y., have a very complete line of belt-driven hydro-extractors. These machines are known as self-balancing centrifugals. This type of belt-driven extractor is constructed with patented adjustable idler pulleys, the use of which makes it possible to have the belt drive above or below the basket.

The lower bearing is flexible, and the control of same is due to the positive action of gravity. A very desirable

Open-Top Electric Underdrwen Extractor. Fletcher Works, Philadelphia, Pa.

feature of this type of machine is that the main bearings are self-aligning, and the lubrication of the bearings is controlled from one point. The lubrication system is such that it is impossible for oil to enter the interior of the basket.

Center-Slung Centrifugal

In some classes of work it is essential that access to the basket be unhampered by belts, pulleys, etc., and such a type of machine is found in the Tolhurst center-slung centrifugal. This extractor is controlled by an under-drive. The outer case, which carries the revolving basket, is held by links supported on three short stands or columns, these links being so placed that they occupy a position on a plane through the mid-depth of the basket. The above arrangement brings about a condition whereby the resultant of the forces of gravity and the unbalanced load of the machine reduce the bearing stress and friction. The friction is further reduced due to the fact that the radial and direct thrust loads are taken care of by three sets of full roller bearings.

The bearings are fully protected from dirt, and correct lubrication with grease results in perfect bearing alignment.

(*Continued on page* 203.)

Self-Balancing Extractor with Belt Drive from Motor. Tolhurst Machine Works, Troy, N. Y.

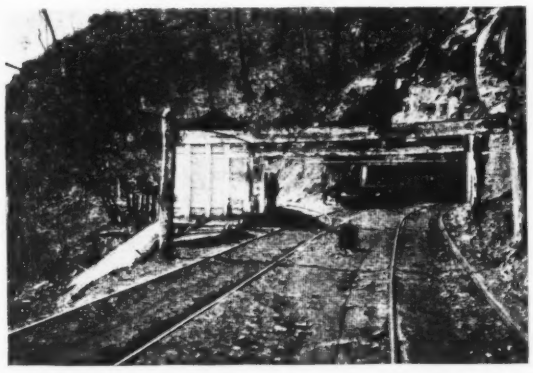
Direct Motor-Driven "Self-Balancing" Centrifugal. Tolhurst Machine Works, Troy, N. Y.

THE NEWPORT COMPANY

Handsome Volume Recently Published Gives Clear Conception of the Ramifications of This Great Organization—"Coal to Dyestuff" Slogan No Idle Phrase

MOST consumers of dyestuffs—not only in this country but throughout the markets of the world—are to-day familiar with the dyewares bearing the "Newport" trade-mark. Comparatively few know, however, that the Newport Chemical Works, Inc., which merchandises these dyes, is but one unit of a vast organization whose constituent parts handle every phase of coal-tar chemical manufacture from the time the coal first leaves the mine until the finished products are in the consumer's hands.

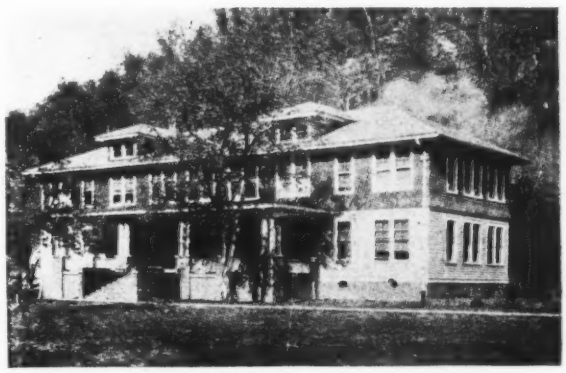
The Newport Company, which is the parent or controlling corporation in this series of associated enterprises, has recently published a handsome and profusely illustrated volume which describes and visualizes all the steps in the production of coal-tar chemicals as carried on by this organization. The present article aims to outline briefly the story told therein and to suggest the nature and variety of its illustrations for the benefit of those who may not have seen the brochure itself.



Pit Mouth, Mine No. 1, Stanaford

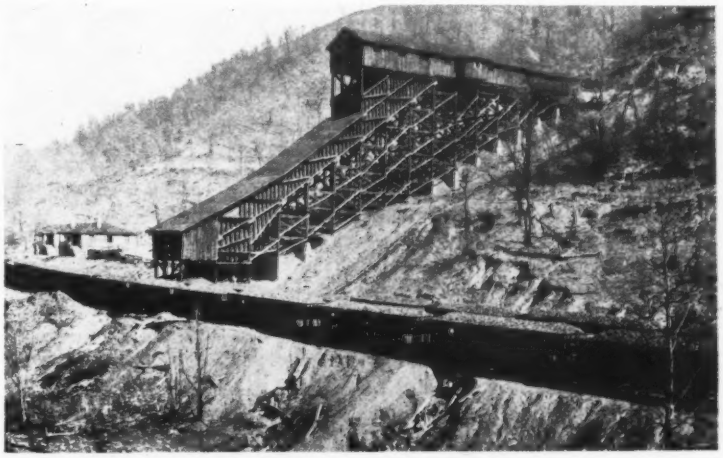
Coal Mines

The Elkhorn Piney Coal Mining Company and the St. Clair Coal Mining Company, whose properties are located near Stanaford, Powellton and Eagle, W. Va., and Weeksbury, Ky., are controlled through stock ownership by the Milwaukee Coke & Gas Company, which is in turn controlled by The Newport Company. The Newport Company operates directly the chemical plant at Carrollville, Wis., which manufactures intermediates, dyestuffs, pharmaceuticals and heavy chemicals. It also owns and operates extensive turpentine and rosin extraction plants at Pensacola, Fla., and Bay Minette, Ala. These plants distill stumpage and lightwood but, because their operations are quite distinct from the coal-tar chemical phase of the company's activities, they are here mentioned only in passing.



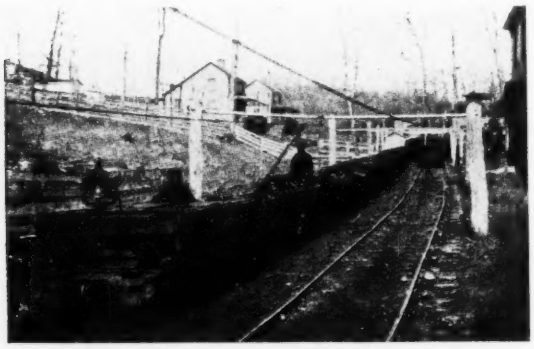
Employees' Clubhouse, Weeksbury

Some conception of the extent of the coal-mining operations of the Newport subsidiaries may be obtained from the following figures: The combined mines have facilities for the annual production of 925,000 tons of coal and the coal reserve is estimated at over 140,000,000 tons. Sixty electric locomotives and over 2,000 mine coal cars are used. In order to assure prompt transportation of mined coal to market, the mining companies and their affiliated industries own 900 50-ton and 300 70-ton steel hopper-bottom railroad coal cars. During the car short-



Coal-Loading Tipple, Eagle

age of 1920 this car ownership proved of great value in enabling the mines to operate on a full-time basis, while neighboring mines dependent entirely on railroad-owned cars were seriously handicapped. The coal mined is described as being admirably adapted for the making of by-product coke, which is in keeping with the primary purpose of affording an assured supply of raw material to the by-product ovens of the Milwaukee Coke & Gas Company. During the lake season the coal mined is shipped by rail to Great Lakes ports, and thence by boat to its destination. During the winter season it moves by all-rail routes.



Mine Locomotive and Load, Stanaford

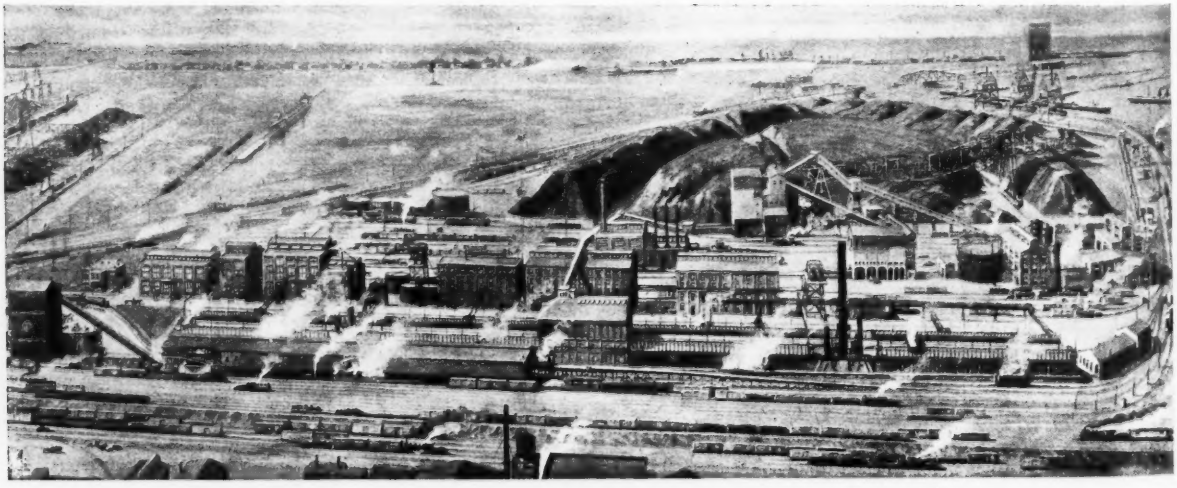
Town of Powellton, W. Va.

By-product Coke Plant

The plant of the Milwaukee Coke & Gas Company is one of the largest and best equipped by-product coke plants in the country. The coal from the mines is received at the company's concrete dock, 600 feet long, whence it is conveyed by a system of belt conveyors over a large pivoted steel bridge for distribution over the storage field. At the time of its construction this bridge (shown in the background of the unloading equipment illustrated) was the largest reclaiming gantry in the world. The coking equipment consists of one battery of fifty 12-ton Koppers cross regenerative combination coke and gas ovens already completed and in operation, with another similar battery under construction. A third battery is contemplated after the completion of the second.

In addition to the production of coke (much of which is utilized by the company's affiliates, notably the Steel and Tube Company of America), the Milwaukee plant recovers the usual by-products—ammonia, benzol, toluol, etc.—which are in large part delivered to the Carrollville chemical plant of The Newport Company and furnish the crude materials from which the intermediates and dyestuffs are manufactured. Most of the gas remaining after the by-product operations is delivered for distribution to the city of Milwaukee for illuminating and heating purposes.

The illustration of the coke plant reproduced herewith gives but an imperfect idea of its mag-



By-product Coke Plant of Milwaukee Coke & Gas Company, Milwaukee, Wis.

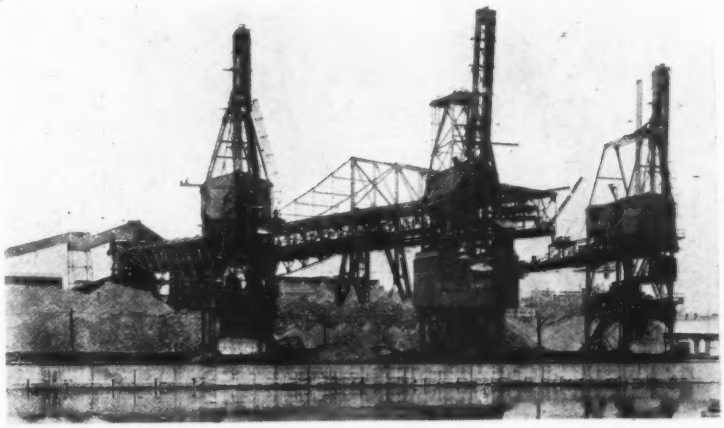
nitude. It accupies an area of twenty-eight acres and has five miles of railroad track on the property. Three steam locomotives and three locomotive cranes are used for the handling of the equipment and the product.

The Chemical Plant

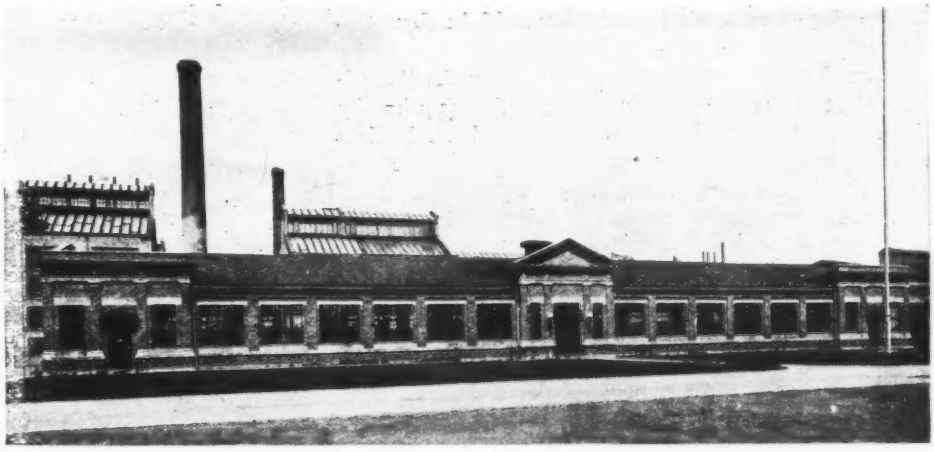
The chemical plant of The Newport Company at Carrollville, Wis., fourteen miles south of Milwaukee, has a property area of 304 acres, with a frontage of nearly 5,000 feet on Lake Michigan. The plant proper occupies fifty-one acres, on which are located forty-three buildings. The principal manufacturing buildings are of reinforced concrete construction and are of a standardized type, having floor dimensions of 204 by 54 feet and a height of 34 feet to the roof truss. It has been found that standardization makes for economy, the installations being readily interchangeable. Concrete roads, with modern motor transport, overhead mains and subway conduits, solve the various problems of conveying materials and products to and from the various warehouses and manufacturing units.

At the present time the plant has an annual productive capacity of 15,000,000 pounds of intermediates, 9,000,000 pounds of finished dyes and pharmaceuticals, and 80,000,000 pounds of heavy chemicals. The manufacture of these quantities requires the employment of approximately 800 men in direct manufacturing work.

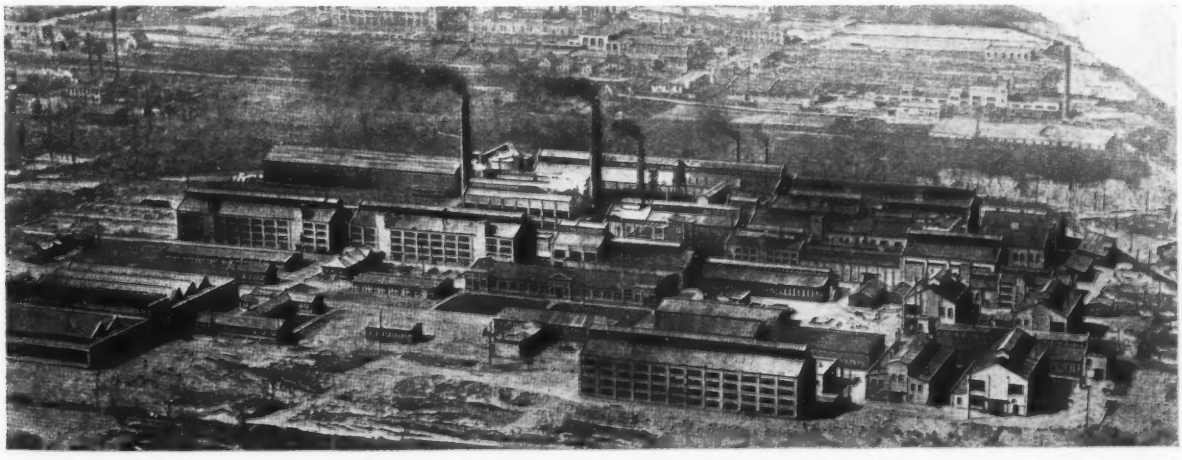
By no means the least important feature of the



Unloading Equipment at M. C. & G. Company's Dock, Showing Pivoted Gantry Bridge in Background



Exterior of Research Laboratory, Chemical Plant, Carrollville



Chemical Plant of The Newport Company, Carrollville, Wis.

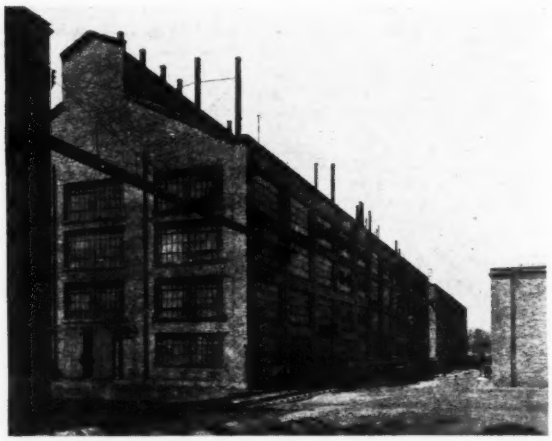
Unit of New Building, Passaic, N. J.

chemical plant is the research laboratory, an exterior view of which is shown herewith. In construction and equipment this laboratory is the finest known to chemical engineering in the United States. The editor of The REPORTER, who was recently privileged to inspect it, pronounced it "complete in every detail."

The Newport Chemical Works, Inc., with headquarters at Passaic, N. J., is a subsidiary of and acts as distributor for the chemical products manufactured by the Carrollville plant of The Newport Company. Although primarily a sales organization, this concern mixes and standardizes the dyestuffs produced at Carrollville. Here are also maintained extensive service laboratories whose chemists are engaged in matching samples, determining the most suitable methods of application, and otherwise assisting the company's customers to obtain the best possible results with Newport colors.

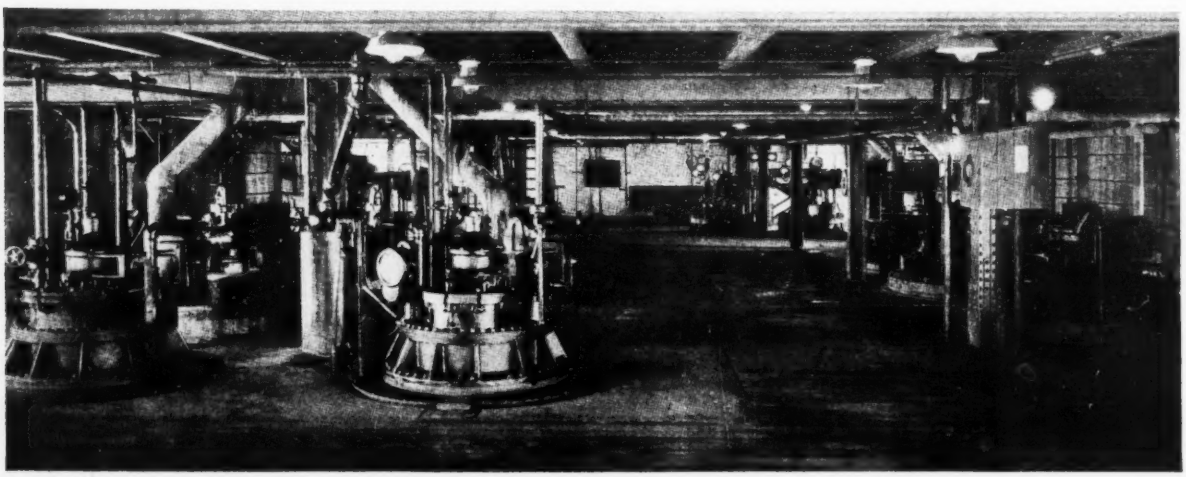
The administration of the sales organization is centered in Passaic, with domestic branches at Chicago, Boston, Providence, Philadelphia and Greensboro, N. C. Sales offices are also maintained in Japan, China and India. The sales personnel includes many men of long experience and high standing in the dyestuff field, of whom the best known to consumers is probably Elvin H. Killheffer, vice-president in charge of sales, who, although identified in pre-war times with one of the leading German dyestuff manufacturers, was among the first to see the opportunity open to America in the manufacture of coal-tar dyes, and whose thorough knowledge of dyestuff chemistry and practice made it possible for him and his associates to seize the opportunity offered.

From the foregoing it will be seen that the company's slogan, "Coal to Dyestuff—Newport All the Way," is no idle phrase. From the time the coal is mined until the finished products are delivered to the consumer, each step



Unit of Standard Type Building, Carrollville

is conducted by a unit of the Newport organization. If our Congress sees fit to grant the tariff protection necessary to prevent German ravages of the American market for but a few more years, consumers may rest assured that this and other similar American dye-manufacturing concerns will ably and amply satisfy their every dyestuff requirement.



Section of Intermediates Plant, Carrollville, Showing Battery of Autoclaves

AMERICAN
DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

LOUIS A. OLNEY
PROFESSOR OF CHEMISTRY AND DYEING, LOWELL TEXTILE SCHOOL
Advisory Editor

LAURANCE T. CLARK
Managing Editor

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Vol. XI September 11, 1922 No. 6

WELCOME

ONCE again The AMERICAN DYESTUFF REPORTER welcomes you to the Chemical Show and calls your attention to the evidences of progress visible on every hand. The 1922 Exposition undoubtedly finds the chemical industry of this country in a sounder position, both from a legal and a commercial point of view, than ever before, and its forward strides during the past year have been thoroughly in keeping with its earlier progress since the war. More than that, it has steadily progressed in a way fully as important—if it is ultimately to make the most of its opportunities—as any rising curves on sales charts can show, or production statistics indicate; it has progressed still further into the public consciousness of its true role as the basis of our future prosperity and our ability to maintain our leadership in all branches of world endeavor. Perhaps no better evidence of its basic character is anywhere provided than in the statement that if all the companies represented at the present Exposition should declare a holiday for one year, every vital industry and enterprise in the country would have to shut down before the expiration of that period.

You who are connected with any of the chemical industries know that it is good for the public to understand a fact like this; you know that representatives of other industries can have no particular interest in making them aware of it, and that if the attitude of the public toward our chemical industries is to be still further influenced in the proper direction, you, as an individual, must take steps to do it yourself. Excellent advancement has been made, but the time has not come—and never will come—when representatives of any industry can afford to sit back and say, "We have arrived."

As heretofore, The REPORTER's booth at the Exposition, No. 743, is being maintained as a reception booth for your convenience, and this year it is the visiting headquarters for members of the American Association of Textile Chemists and Colorists. In accordance with previous announcements, there is provided a register wherein all members should place, early in the week, their temporary addresses, telephone numbers, and any other data leading to the establishment of easy exchange of communication and the making of appointments.

All of our friends should avail themselves of this convenience. They will find those in charge of the booth always ready to take messages, look after personal property, and render any kind of service within their power. No one should hesitate to make use of whatever facilities we can offer, as this booth is intended expressly for the convenience of visitors.

EXECUTIVES FOR THE AMERICAN DYE INDUSTRY

FROM time to time The REPORTER has sought in these columns to lend added impetus to the growing opinion that the American dye industry should endeavor to recruit its executives from the ranks of its technically trained men.

It is generally understood that the industry to-day is directed by men of unquestioned executive ability, but that these have been drawn mainly from among lawyers, bankers and the heads of miscellaneous commercial enterprises. They are financial and legal experts, men of acumen and sound commercial judgment, wise in the management of office forces and the general conduct of commercial enterprises. But the dyestuff industry, strange though such a statement may sound, is not, primarily, a commercial enterprise in the generally accepted interpretation of the term. It is commercial in so far as it must sell its products, keep track of its employees and exercise personal control over the actions and spirit of the latter. But even the selling of dyestuffs to consumers is far, far from ordinary commerce and trade as most people understand them.

Since the proper mental background necessary to develop the instincts—reason alone, paradoxically, appears to be insufficient—essential to the successful conduct of such an enterprise as a coal-tar dyestuff manufacturing concern, takes longer to acquire than is the case in almost any other industry, these executives are, it would seem, really handicapped and are therefore unable to make the most of their undoubted ability to lead and handle men.

It has been pretty well demonstrated by this time that in this particular industry there is no substitute for actual technical training, followed by a long course of practical experience in the works and mill. If from among men of this sort there can be found some who, in addition, were born with the gift of organizing and directing, the ideal leaders for the industry will have

been produced. The Germans years ago recognized and proved the soundness of this principle, and the fallacy of the other.

Of extreme interest in this connection is some of the comment provoked by the third general meeting of shareholders of British Dyestuffs Corporation, Ltd. The Manchester Guardian prints an article by Prof. Henry E. Armstrong in which the latter, after decrying the position of British schools and colleges with regard to anything practical, and the failure of the country to support Hofmann with trained technical workers when he was endeavoring to build up a synthetic dye industry in England, speaks his mind plainly on this subject, even at the cost of some criticism of the late Lord Moulton and Sir William Alexander, chairman of the board of the corporation above referred to. Prof. Armstrong writes:

"Our attempt to re-establish the dyestuff industry has been on the wrong lines from the beginning. Great as was the ability of Lord Moulton, he had neither the scientific nor the practical knowledge to grasp the intricacies of the situation . . . all others who pretentiously attempted to deal with it were grossly ignorant even of its A B C. The action of Government in giving the enterprise they subsidized into the control of a Scottish solicitor was emblematic of their entire failure to appreciate the nature of the problems to be solved.

"When addressing the members of the House of Commons recently, Sir William Alexander is reported to have said:

" 'If you will examine those who lead the various dye companies in other countries you will find that in some cases a financier is at the head, in some cases a commercial man, and in some cases a technical man. These do not keep their positions because of their commercial, financial or technical knowledge, but because of their administrative skill.'

"This does not suggest that Sir William Alexander knows what is customary in other countries or has sufficient understanding of the requirements of the industry. A Colossus capable of dealing with it as a whole has yet to be found. The attempt has never been made in Germany; there the directorate has always been constructed on the wheel principle. . . .

"What we have first to do in this country [England] is to overcome the conceit of the commercial mind—to disabuse it of the idea that it is competent to exercise undivided control. Before you can sell you must make; the maker is at least as worthy as the seller. . . .

"The story of the way in which the British Alizarine Company broke the German ring is well known. Because users co-operated fully with producer, this company carried on a respectable existence; but it never really got up steam; it showed no go, no originality; but it carried out its first simple program. . . . Knowing something of the management, I can understand their failure to advance; the office spirit prevailed."

More quotations of a similar nature could be given, probably will be given in a succeeding issue; but the above is sufficient to show that the American dye industry is not alone in facing the problem of securing the most efficient control. Whether the control is better, equal or worse in this country than it is abroad is beside the point for the time being; the question is not one of how well or how ill the majority of our dye companies have been managed. Instead, the belief here expressed is that if the results had been just twice or three times or four times as excellent, they still would be short of what they might have been under ideal conditions of control.

Failure to recognize this need for technically trained executives may yet cost the American dye industry dear, in spite of any favorable action which the Senate conferees may take with regard to the pending tariff rates based on American valuation. The question is one deserving of agitation up to a point of producing action, and The Reporter will at all times be glad to receive and print opinions either for or against this view. It is the plain duty of all those who have the best interests of the industry at heart to contribute whatever facts they may have at hand, to seek for new facts calculated to shed more light on the question of control of the American dye industry by experienced, trained dyestuff men, and to keep this subject before the industry until sentiment shall have crystallized.

A TRIBUTE

With the recent death of Dr. Jokichi Takamine, the world lost a distinguished citizen, a great man of science, an impelling force in the promotion of better understanding between Japan and the United States, and, above all, an estimable gentleman. It is a loss keenly felt not alone by those who enjoyed a personal acquaintance with this notable figure, nor solely by those in a position to appreciate his scientific attainments, but by all who recognize the benefits of a broad vision and humanitarian outlook when coupled with mental prowess and the energy to labor hard for an ideal. Japan may well be proud to have produced a man of his caliber; America was honored by his residence and activities here.

Born in the Province of Kaga, he came of distinguished lineage. His serious studies began at Nagasaki and were continued at Osaka, where he went to study medicine. He was a graduate of the Imperial University of Japan and completed his education at the University of Glasgow and the Andersonian University, Scotland.

Surgery, as well as humanity in general, appreciates and recognizes the value of adrenalin, the active principle of the suprarenal gland which Dr. Takamine succeeded in isolating in 1900. This raises blood pressure by contracting the small arteries, thereby making

possible bloodless surgery in minor operations, particularly those on the eye, ear and throat.

His discovery of takadiastase antedates his production of adrenalin by six years, and ranks among his most important contributions. This is obtained from

Dr. Jokichi Takamine

a fungus growth, and is in wide use by physicians for starch digestion, and is to-day a remedy known to all pharmacists.

It is for the discovery of takadiastase that Dr. Takamine was best known to the textile industry, for it is this agent which forms the active principle of "Polyzime," now so generally used in place of malt extract for rendering textile starches soluble.

A full outline of Dr. Takamine's career cannot be given here, but one of the acts for which he will be remembered was his unstinting service, even at peril of his failing health, in support of the activities of the Limitation of Armaments Conference in Washington.

His activities and affiliations show perhaps better than anything else his abilities and standing both here and in his homeland. He was made Doctor of Chemical Engineering in the University of Japan and Doctor of Pharmacology in 1906. He was decorated by the Japanese Emperor with the Fourth Order of the Rising Sun in 1915, having been appointed member of the Royal Academy of Science by the Emperor in 1913. He was president of Sankyo & Co., Ltd., Tokio; Takamine Ferment Company, International Takamine Ferment Company, Takamine Laboratory, Inc., and Takamine, Inc.

He founded the Nippon Club of New York, the Japan-America Society, the Chemical and Physical Research Society of Japan, and was prominent among the founders of the Japan Society of New York and the Japanese Association of New York. He was a member of the Lotos, Chemists, Drug and Chemical, New York Athletic, Merrieworld, Bankers and Nippon clubs, the American Chemical Society, Royal Chemical Society of England, Institute of Chemical Engineers and the Franklin Institute.

EDWIN G. QUIN

With deep regret we announce the death of Edwin G. Quin, vice-president of John Campbell & Co. and the Amalgamated Dyestuff & Chemical Works, who passed away September 5 at Avon-by-the-Sea, N. J.

Mr. Quin was born in Portland, Me., forty-four years ago. He entered the house of W. J. Mathewson & Co. when a lad and remained with them until 1915, and subsequently joined the staff of John Campbell & Co. Mr. Quin had many friends in the dyestuff industry and was acknowledged as one of the best posted men in the field. He took an active interest in the affairs of the American Association of Textile Chemists and Colorists from its inception, and was secretary of the New York Section of this organization at the time of his death.

In Mr. Quin's death the American dyestuff industry has lost one of its most energetic and able men—a man intensely interested in the manufacture and merchandising of coal-tar dyestuffs. His untiring and sincere efforts always inspired those with whom he came in contact to greater achievement. Mr. Quin will be greatly missed in the dyestuff industry.

TECHNO-INDUSTRIAL PHOTOGRAPHERS TO MEET AND EXHIBIT AT CHEMICAL SHOW

The newly organized Technical Photographic and Microscopical Society will hold a meeting in conjunction with the Eighth National Exposition of Chemical Industries at Grand Central Palace, and various divisions of this body will also exhibit. The decision was reached at a luncheon meeting last June at the Hotel Astor, New York, when the Society accepted the invitation of Charles F. Roth, of the Exposition management, to make use of one of the halls for lectures and meetings.

The sub-committees of the general committee on exhibits devoted to the textile division of this techno-industrial photographic society consist of: Boston, Russell T. Fisher, chairman; E. D. Walen and Arthur H. Grimshaw, who will present a paper under the title "The Use of the Microscope in the Textile School"; and, New York, W. O. Jelleme, chairman; K. B. Cook, and Douglas G. Woolf.

Speakers at the June meeting of the Society included John H. Graff, of the Research Department of the

(Continued on page 205.)

MEN OF MARK
in the
DYESTUFF FIELD

CHARLES F. GOLDTHWAIT

Chief Chemist
in charge of research and dyeing

Klearflax Linen Rug Company
Duluth, Minn.

CHARLES F. GOLDTHWAIT was born in Cummington, Mass., April 23, 1886, of American ancestry. Since Cummington was the birthplace of William Cullen Bryant, and the day and month are the same as those of Shakespeare's nativity, it is difficult to see, he declares, "what excuse I had for becoming a chemist."

His early education was received at the public schools of Athol, Mass., and at the Dalton, Mass., High School. He was graduated in 1909, with the degree of Bachelor of Science in Chemistry, from the Worcester Polytechnic Institute, at which institution he was elected to Sigma Xi.

On the completion of his education, he went immediately into the employ of S. Slater & Sons, Inc., at Webster, Mass., where for the next seven years he had charge of the laboratory work on cotton, woolen, worsted and printing. It was in 1916 that he became connected with the Klearflax Linen Rug Company, acting first as dye foreman as well as chemist, and working out methods of degumming and dyeing flax tow made from threshed seed flax straw. One of the interesting developments in this plant, where stock is figured and handled by the ton, was the dyeing of 5,000-pound batches of tow in black and fancy shades.

Mr. Goldthwait now has general oversight of dyeing and chemical operations at this plant and is in charge of various research and development projects. He recently visited important European flax districts for a study of retting and mechanical operations in the preparation of flax.

He is a member of the American Chemical Society, the Society of Chemical Industry, the Society of Dyers and Colourists, the American Association for the Advancement of Science, the Duluth Engineers' Club, and the American Association of Textile Chemists and Colorists. He has been a frequent contributor of articles, mostly of a technical nature, to the textile and dye trade press, and one of these, in which he establishes a strong case for the acceptance of textile production as a true chemical industry, appears elsewhere in this issue.

CENTRIFUGAL EXTRACTORS

(*Continued from page* 194.)

Of late years, the development of the steam turbine and of electricity have introduced a new means of power which the manufacturers in general have been quick to grasp.

The proper application of these two sources of power has resulted in a decided improvement in the individual driving of many kinds of machinery, and such sources of power are particularly adapted for use in the running of hydro-extractors.

Direct Motor-Driven Hydro-Extractors

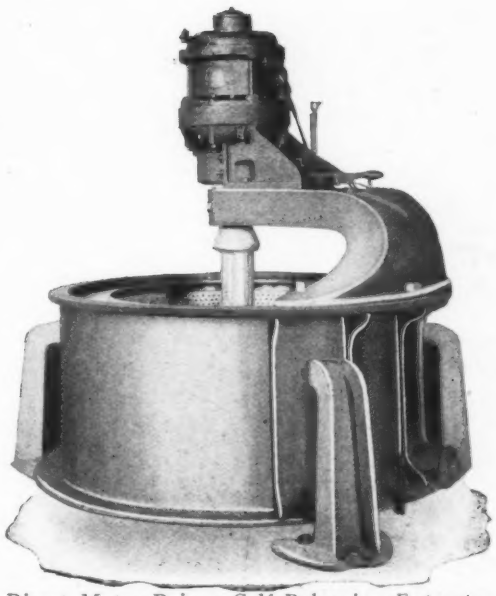
The trouble experienced in the early stage of the direct

"Hercules-Electric" Bottom-Discharge Self-Balancing Centrifugal. East Jersey Pipe Co., Paterson, N. J.

motor drive was largely due to the difficulty in constructing a motor which would deliver the great amount of electric power required for the starting of the machine, and which would thereafter deliver the relatively small amount of current required to run the extractor.

This difficulty has now been overcome by means of an automatic centrifugal clutch which absorbs the initial power of the motor and properly distributes the power as the extractor attains the proper speed.

The Tolhurst direct motor-driven centrifugals of the "self-balancing" and "center-slung" type have all the ad-



Direct Motor-Driven Self-Balancing Extractor. Fletcher Works, Philadelphia, Pa.

vantages of the belt-driven machines and in addition have the decided advantage of an efficient direct motor drive.

Those who now have the belt-driven Tolhurst extractors may have them converted into direct motor-driven machines by use of a special clutch pulley.

The East Jersey Pipe Company, Paterson, N. J., makes an extractor known as the "Hercules-Electric," which is a direct-driven machine.

The Hercules extractor is fitted with an ingenious tilting mechanism which enables the motor to be swung away from the top of the basket, thus making renewals, repairs, etc., easy of attainment.

The Fletcher Works, formerly Schaum & Uhlinger,

"Hercules" Extractor, Showing Motor Tipped Back to Facilitate Removal of Basket. East Jersey Pipe Co., Paterson, N. J.

Inc., Philadelphia, Pa., manufacture a direct motor underdriven extractor in which an induction motor is used. The motor and basket are on the same shaft, thus producing an extractor having but one moving part, which does away with the necessity of a centrifugal clutch, flexible or other coupling.

The extractor is fitted with two extra large ball bearings, the lower bearing running in an oil bath, while the upper bearing is lubricated by a device for circulating the oil, which is controlled by a sight feed. The extractor is fitted with an interlocking lever, so that the current is automatically shut off when the brake is applied.

The Fletcher Works also make a hydro-extractor the power of which is derived from a direct-connected steam turbine. This type of machine, where steam is available, offers a very fine type of drive. The turbine is wholly enclosed, and no belts are required. The speed is controlled by a governor. Inasmuch as the turbine does not introduce any oil into the steam, the exhaust steam is available for various uses where low-pressure steam is suitable, such as heating, boiling, drying, etc. The bearings are lubricated in oil baths. The baskets can be quickly brought to full speed, the speed being accurately regulated and controlled by a governor which is of a type generally employed on large turbines.

In addition to the general types of extractors mentioned, there are also the small hand-driven extractors which find a very real use in certain classes of work where the demand is not sufficient for a power-driven centrifugal.

Another type of extractor is that driven by means of a cone and friction plate. This machine is so constructed as to allow for excellent distribution of power both in the starting and in the running of the machine.

CARBONIZING RAW WOOL AND NOILS BY THE SULPHURIC ACID AND ALUMINUM CHLORIDE PROCESSES

(*Continued from page* 192.)

except as an aid to control in the mill when used in connection with a laboratory determination of actual acid present.

The specific gravity of aluminum chloride solutions tells no more than that of the sulphuric acid. While the writer has found variations from 4.5 to about 22.00 per cent actual Al_2Cl_6 in the aluminum chloride bath, a content of 6.5 to 9.00 per cent Al_2Cl_6 will usually cover all classes of work. Higher percentages of aluminum chloride in the bath only increases the cost of the operation.

Drying and Carbonizing the Stock

When the stock leaves the squeeze rolls of the reagent tank or bowl, it is ready for the third operation. Some plants are arranged with a conveyor belt to carry the stock from the rolls to the carbonizer or dryer feed. The carbonizers are usually built much like a continuous apron dryer used in drying scouring wool, such as shown in *Fig.* 5. These dryers are usually steam heated and equipped with blower fans as shown in *Fig.* 8. Suitable valve arrangements are made for regulating the temperature. Some types are higher, broader and shorter than the usual scouring dryers. In the high type there are usually three or more belts or aprons arranged one above the other, and feeding downward from the top onto the lower apron. *Figs.* 6 and 7 show the feed and rear ends, respectively, of a three-apron dryer.

The stock is fed onto the top apron and after traveling the length of the dryer, drops down to the next apron, etc. The highest temperature is usually maintained in the lower part of the carbonizer by means of baffles or dampers placed in the upper part of the carbonizer between the aprons. Sometimes a separate dryer is placed between the reagent tank and the carbonizer proper. This dryer feeds into the carbonizer.

In the sulphuric acid carbonizing process, the best results are obtained by drying the stock at about 160 deg. Fahr. until it contains about 12 to 15 per cent reagent as condition, and then baking it in the carbonizer proper at about 220 deg. Fahr. until it contains 1 to 2 per cent condition, by which time the vegetable matter usually appears black, charred and brittle.

The operation of the carbonizers possibly calls for more control and judgment than any other part of the carbonizing process, as it is here that it is easiest to permanently injury the stock or cause incomplete removal of the vegetable matter.

In the aluminum chloride carbonizing process, the stock is first dried at about 160 deg. Fahr. and then carbonized at about 240 deg. Fahr. Aluminum chloride is not decomposed below about 225 deg. Fahr. and therefore a carbonizer temperature higher than this must be maintained. In the carbonizer at temperatures above 225 deg. Fahr. the aluminum chloride solution in the stock is decomposed into basic aluminum chlorides, aluminum hydroxide, aluminum oxide and hydrochloric acid gas. This hydrochloric acid gas acts upon the cellulose of the vegetable matter to form a hydrocellulose which is readily removed from the stock. So that while a temperature of over 225 deg. Fahr. must be maintained at all times, it must not greatly exceed this or the high temperature of the carbonizer will certainly permanently injure the stock in every way; color, strength, etc. At the same time too low a temperature or too short a time will fail to properly carbonize the vegetable matter and it will not all be removed in the subsequent passage through the crush rolls and dusters.

There are two possible methods of controlling the carbonizer results, i. e., by means of the temperature maintained in the carbonizer; or by the length of time the stock remains in it. The speed of the belts or aprons can be varied to govern the length of time the stock is in the carbonizer, and, of course, this alters the capacity of the machine. The easiest and most satisfactory way is to change the temperature by means of the steam valve. Of course, the depth of the stock upon the apron could

be varied more or less, but it is much the best to keep the stock thoroughly spread out over the apron in a thin, even layer, so that it dries out and is baked evenly.

Even though the temperature is bound to vary considerably on account of fluctuations in steam pressure, variation in moisture content of the stock, and the amount of stock passing through the machine, etc., it is surprising how often carbonizers are operated without reliable thermometers. Or if a thermometer is provided, how seldom some men use it. Every carbonizer should be provided with a half-dozen thermometers located in different parts of it, and with a centrally located graphic recording thermometer, so that a permanent record is kept of all fluctuations in temperature. This recording instrument removes most of the chances for argument as to who is responsible for stock injured in the carbonizer, or for imperfectly carbonized stock. If the temperature is carelessly regulated, it soon shows up on the chart, and a change of operators can generally be made before much damage is done. The writer has never seen a thermostatic valve used upon a carbonizer, but there is no reason why they could not be used to good advantage. If properly installed they would maintain a far more even regulation than is possible with hand valves, and avoid damage due to high temperature in case the carbonizer accidently stops for a short time. However, it is impossible to keep the temperature uniform in all parts of the carbonizer, no matter how it is regulated.

For aluminum chloride work, if the temperature of the carbonizer is about 235 or 240 deg. Fahr., the speed of the aprons and the feed should be so adjusted as to leave about 1 or 2 per cent condition in the stock as it leaves the carbonizer. If this stock is not then properly carbonized, the fault lies with the reagent or the manner of immersion. For sulphuric acid work the same conditions will apply except that the temperature will be lower, i. e., about 225 deg. Fahr.

Dusting

In many instances the carbonized stock is shipped from the carbonizing plant without being passed through the crush rolls or dusters, but generally it is put through a series of corrugated rolls and dusters to remove the carbonized vegetable matter. *Figs.* 9 and 10 show sets of these crush rolls and dusters. These are often operated in a series of as many as ten or more sets of rolls and dusters in order to completely remove all traces of the vegetable matter. The carbonized vegetable matter and dust are blown out of the dusters by the fans shown on top, as refuse. The refuse matter from the aluminum chloride process of carbonizing is very high in alumina and, of course, contains some aluminum chloride and wool dust. Carbonizing refuse is sometimes sold to fertilizer plants as a source of nitrogen.

Stock carbonized by the sulphuric acid process is sometimes, but not always, neutralized with soda ash or other alkali. Sometimes it receives a rinsing with fresh water only, but even this is not always done, especially if it is soon to be acid dyed as loose stock. Stock carbonized by the aluminum chloride process is seldom neutralized or rinsed at the carbonizing plant.

TECHO-INDUSTRIAL PHOTOGRAPHERS TO EXHIBIT

(*Concluded from page* 201.)

Brown Company, Berlin, N. H., who said that the problems of industrial photography lay in a higher field than that occupied by the average commercial photographer, and cautioned against any confusion between techno-industrial photography and commercial photography in the generally understood meaning of the latter term. Technical photography, he declared, implied a knowledge of other sciences, as engineering, chemistry, physics, optics and mathematics, and he suggested that subjects coming within the scope of the new society might be summarized as follows:

1. Work done with the ordinary camera as a tool of management, such as records, demonstrations of waste, etc.

2. Photomicrographic and macrographic work, formerly done only by the scientist in pure research, but now being more and more used to solve daily commercial and industrial problems.

3. Photographic work requiring specially constructed equipment, such as motion pictures, making possible the detailed study of breaks or stress in physical tests, etc.

THE VELOUR FINISH

The velour or velvet finish for woolen top clothing has always been more or less in favor. Its chief characteristic, of course, is a velvety handle, but the methods of production also tend to a lustrous appearance, and where high colors are introduced, the effect is softened. The finish is confined to wool fabrics, as worsted yarns are not adapted to it. The wool used is invariably of a Saxony rather than a cheviot class. It will be understood that the finish is confined to the face of the fabric, and there is no particular regard for the back.

Fabric Construction

The fabric must be constructed in a way that will provide suitable foundation for the vital nap-raising operation in finishing. It may be well to explain here that a short thick nap is always preferable to one that is longer and not as compact. Calculations for layouts should be according to the idea of good felting wool, with yarn of a size that will not show the form of construction threads in the finished goods. In the same connection, while the raw fabric should be fulled to handle firm and clothy, it should not be fulled beyond the capacity of the material,

otherwise fibers will be broken and matted on the surface. In such a condition they cannot be raised to good advantage, and will reduce the quality of velour finish.

A better result can be obtained with plied than with single yarn, because the threads are more round and smooth, and the fabric stands out better and displays a more compact and lustrous appearance. The plied yarn fabric is also better able to withstand the weakening effect of gigging or napping, and as the nap is raised from a better developed and smoother texture, it is more efficient in regularity and wearing properties.

Both the ordinary wire clothed napping machine and the teasel gig are used to raise the nap upon the fabric, and there are finishers that favor each machine. The demand for velour finish woolen fabrics has been increasing for some time back, and as a result a domestic grower of teasels has advertised the fact that he has been compelled to extend his farm in order to supply the wants of his customers.

Finishing Operations

For the finish in question, the cuts of raw fabric from the loom are first trimmed and burled, by clipping off surplus ends of yarn and projecting knots. The latter is particularly important, as knots that are allowed to remain are likely to cause holes and unsightly marks on the finely finished face of the cloth. The holes are made by knots coming in contact with the cutting parts of shearing machine, and the unsightly marks are produced by knots causing the fabric to be unevenly gigged. It is also essential for the avoidance of objectionable marks or streaks that all missing ends be replaced, also wrong draws or misplaced threads made right.

Fulling

There is no special need to run the pieces through a soaping machine previous to fulling, but for evenness of fulling it is important that the pieces be thoroughly wetted throughout before the felting process begins. This is usually accomplished by running them in lukewarm water in the fulling mill for about ten minutes before soap is applied. Fulling treatment is then given in width and length to the extent calculated for in the layout.

With fulling, washing and extracting completed, the pieces of cloth in the damp state are gigged on the face. The nap is raised to the required erect position and the goods are kept as moist as possible without dripping, which keeps the teasels, where these are used, in a good working condition. As on other classes of goods the gigging is started with partially worn-out teasels, and care must be taken to prevent fibers from being pulled out. For this object the cloth is kept from coming too heavily in contact with the teasels. This also prevents the nap from being flattened down. The idea is to have the nap as lofty and free as possible.

Raising the Nap

Gigging is different than for other classes of goods. A sharper teasel surface is needed because the cloth is not brought so close in contact. The teasel surface should be keen enough to lift the fibers rather than to drag them lengthwise. After gigging has progressed to the stage where the keenest surface is employed to raise the bottom fibers, the cloth should be put in closer contact to allow the teasels to reach the nap and raise the remaining fibers. At this stage care must be exercised so as not to injure the construction threads.

After the cloth has been properly cleared and gigging or napping is almost completed, the finishing runs are given with the pieces reversed end for end. The last runs should bring the nap to an erect position, hence the cloth is brought only lightly in contact with the points. They must be given evenly so that no streaks or faulty marks will be present in the finished goods. Probably these defects will show if the nap is inefficiently raised.

While the napping is in progress the pieces should be reversed repeatedly, except in case a double cylinder gig is employed, on which the cylinders should be run in reverse directions until the finishing runs are given, when it is necessary to set the fabric off from the back cylinder. To overcome any difficulty on the double cylinder gig, it is a good method to run the pieces last end first throughout the operation, and for the finishing runs to use the back cylinder only.

Drying and Pressing

If speck dyeing is needed this is next in order, after which the goods may be given a bath of water mixed with fuller's earth, which imparts a soft and pleasing handle to the cloth. It is essential that the drying machine should be kept continuously in motion during the drying process, otherwise there will be a streak wherever the face of cloth comes in contact with the rolls of the machine.

After drying, the cloth is taken to be sheared. In this process the raising brush must be applied only lightly or it will tend to turn the nap over. The nap is lofty and in an erect position on account of the previous treatment the cloth has been given. The back or laying brush should be put in efficient order so that the nap may be properly laid on each run. The cloth should not be sheared too closely, for with the treatment received the nap is in such a condition that the colors and pattern will show up nicely, while its erect position will give the desired velour or velvet handle.

In the pressing operation the cloth is run through with the face up and last end first. In subsequent steam brush only enough steam must be applied to remove the gloss of pressing, and not enough to affect the back of the cloth. The contact of the brush against the goods should not be severe. In this way the cloth will be appropriately smooth and the position of the nap will easily be felt.—"Textile World."

ACCURACY IN COLOR MATCHING

(*Concluded from page* 186.)

In the first test several observers made color matches using two tungsten lamps so set that there was an illumination of 5.1 foot candles on the photometer screen. It was found that experienced observers agreed in their setting to an accuracy of about 3 deg. K., while inexperienced observers differed by only about 5 deg. K.

There was also a test made to see if there was any difference in the accuracy depending upon the illumination on the photometer screen. Tests were made by several observers for illumination varying from 1.8 to 45 foot candles. There were no very definite differences in accuracy found for the different illuminations.

A lamp was very carefully color matched with the color standard maintained by the Nela Research Laboratory and sent to the Bureau of Standards to be compared with their standard color. The average of the value obtained before it was sent to the Bureau of Standards and the value obtained after it was returned was 3087 deg. K. The value found by the Bureau of Standards was 3085 deg. K. Later a lamp was sent to the Laboratory from the Bureau of Standards and compared with the standard of the Laboratory. The values found by the two laboratories agree exactly, the value being 2348 deg. K.

The above tests indicate the accuracy that may be obtained in such work both in making the color matches and in determining the color-temperature scale in different laboratories.—"Journal of the Franklin Institute."

Textiles: A Chemical Industry

The Chemist a Dominant Figure—Chemistry of Textile Materials—Man's Successful Imitation of Nature via the Chemist's Laboratory—His Aid and Methods Required with Every Step—Myriad Roles and "Duties"—Real Service Not Replaceable by Any Other Science

By CHARLES F. GOLDTHWAIT

Chemist, Klearflax Linen Rug Company, Duluth, Minn.

SOME people still wonder why chemists should become entangled with textiles, and about once in every so often it becomes necessary to demonstrate how this can be. It is a fact not yet sufficiently realized that the textile industry is chemical from start to finish, and it is a strange fact that new knowledge showing the connection is being published faster than any one individual can absorb it.

There's Cotton, for Instance

Cotton is a chemical. The dimensions of a cotton fiber are about as incomprehensible as the figures that represent the world's war debts—and about as far to the other extreme—but this minute unit, this tiny piece of lint, is a chemical product of nature's laboratory and before we get through with modern research we may find that it is virtually a single gigantic molecule of earth's most versatile and valuable building material, cellulose. Without the aid of churning liquids, powerful chemicals, electric currents or roaring furnaces, the water from the soil and the carbon dioxide from the air are quietly brought together into chemical union and our cellulose fiber grows with 8,000 others on a single cotton seed. A bale of cotton is an almost pure chemical raw material, recognized as such readily enough if it is going to make guncotton or "movie" films, but not so thought of when once it enters a cotton mill.

Flax, which grows in a different way, is also a chemical substance, indistinguishable from cotton when both are in their purest state if it were not for its slightly different appearance under the microscope and its strength and durability in use. It is a chemical raw material, and, as with cotton, constant vigilance is required lest it be acted upon by the chemical reagents necessary to remove its impurities and which cause irreparable damage to the cellulose itself if they but temporarily get beyond control and react with it.

The sheep and the silkworm are also chemical factories turning out their fibers, synthesized from vegetable material and with nitrogen built into the molecule.

The Chemist's Encroachment on Nature's Field

Man has always thought that he could improve on nature, but he was almost stumped when he came to the textile fibers. Countless wonderful things have been done with those that he found ready made, but only in very recent years has he succeeded in making new ones for himself. Now, however, the artificial silks, while not strong enough for all purposes, are shinier than any other textile and have found their way into many useful or decorative effects. Their manufacture is, beyond an argument, a chemical industry, and by its aid the most minute of cellulose fibers—cotton not long enough to cling together in a

thread, or the fine fibers from wood pulp—are dissolved in chemical reagents, soon to appear again in new form as larger, more lustrous filaments, which can be manipulated and made into the many familiar forms. The story is similar for cotton or flax and for all the other natural fibrous materials which have been used for fishing nets, cables, clothing and many other purposes throughout history.

Nature's chemical effects do not always cease with the making of the cellulose, for with flax and other bast fibers she also assists in the first manufacturing operation, retting. In its simplest form this is the mere spreading of the harvested plants on the ground to be acted upon by the sun, rain and dew. The pectin and other "gum" constituents which tightly bind the fibers to the stem are changed chemically by bacterial action and partly washed out, leaving the fibers easily separable from the woody core and from each other.

Physics, Chemistry, and the Gentle Art of Wool Scouring

Wool also encounters chemistry again early in its career, for as soon as it has left its natural habitat and reached the mill it must be scoured free from grease and other dirt. The soap and soda or potash used are chemicals, although the action itself may be classed as bordering on physics. Since it is about as easy to separate physics from chemistry as it would be to split a wool fiber lengthwise, our position is rather safe. One thing, however, is sure: If the wool scourer does not look out he will get "chemistry" enough, and to spare, for woe be unto him who gets his alkali too strong or his bath too hot, since wool is a sensitive chemical material and easily turns brown and harsh, losing strength and other valuable qualities. It can so easily react with the detergents that are supposed only to affect its impurities that as close a control is required with it as with many operations more commonly recognized as chemical processes.

Silk and cotton are more likely to get their first contact with industrial chemistry at a little later stage, for they are free enough from impurities to be made at once into yarn or cloth, more convenient forms for handling. Silk then gets a treatment much like wool, but since cotton's cellulose is a hardier or a more resistant chemical than the keratin of wool or the fibroin of silk, it can be, and in fact has to be, treated with stronger reagents for longer periods of time and at higher temperatures to fit it for dyeing and finishing in attractive form. This is the operation of bleaching, indisputably chemical and sharing largely in the country's trade in heavy chemicals, for caustic, vitriol and bleach, as well as other acids and alkalies, are the chief participants.

Ground Not Unfamiliar to Readers

When the wool and silk are sufficiently cleaned (or bleached if necessary) and the cotton and linen have been bleached to the desired degree of whiteness, we proceed to dyeing or printing. Since printing is merely local dyeing, i. e., dyeing in artistic spots and streaks, it will not add weight to our theme to give it separate discussion. Far be it from a mere textile chemist's thought to say dogmatically that dyeing is a chemical phenomenon. The chemists and physicists both have liens and mortgages on this field, and it will take more than a lawyer from Pennsylvania's well-known textile center to decide which has the first and which the second. Again, what is the difference, anyway? Dyeing, however, introduces dyes, and these are the very aristocracy of chemicals, products of the most highly developed scientific research and of the most involved chemical syntheses.

After dyeing comes finishing, the final beautifying for the market, and a host of chemical materials find employment to add firmness or softness, weight, luster and all the other properties so indefinitely but expressively described as "feel." Finishing, however, is much more than adding foreign materials to cloth and, here also we shall find physico-chemical effects coming into play—effects which will explain results now obtained empirically, whose "theory" is not yet understood.

The Chemist: His Roles in the Textile Industry

So much for the broader aspects of chemistry in textile manufacture, and now for the chemist himself. In modern mills he begins by testing the supplies to see that his employers do not get cheated by accident or design. The chemical supplies must be pure enough as well as of the strength paid for, the dyes must be made of dyestuff and not of salt, the wool must *be* wool and not excessive moisture or grease, and so on through the hundreds of items, great and small, that enter into textile manufacturing. Many of the methods for testing dyes or chemicals have to be designed to fit particular uses for these materials. For example, if dyes are to be used in a kettle containing copper it is well to have a little chunk of copper in the laboratory dye pot to see if it affects the color. If sulphate of alumina is to be used for waterproofing cotton cloth, a little iron in it does not matter, but if it is going to be used for printing alizarine red, then that trace of iron will destroy the characteristic brilliant red and spoil the result. These, the first illustrations that come to mind, are typical of many difficulties which may arise through lack of proper choice of supplies.

Now assuming that just exactly the right things have been bought, we have only avoided a few of the textile chemist's troubles. No sooner are the acids and

the alkalies and the bleaching agents set to work than they immediately begin to go astray. If left to themselves, first you know the "sour" is not all washed out of the cotton cloth and it begins to fall to pieces on the dryer; or the caustic soda on the mercerizing range is getting too warm and forgetting to mercerize; or perhaps the calcium hypochlorite which is supposed to be bleaching has changed slowly to the quite inactive and useless calcium chloride, and many yards of cloth will have to go back and be done over. Barring gross human errors, all these and similar troubles can be avoided by the routine use of simple chemical (or physical) tests; hence, process control is one of the textile chemist's most important functions.

Real Service in Many Ways

The yearly crop of styles is eloquent enough testimony of the chemists's and colorist's activities along these lines. Some new lines are the result of just ordinary everyday work, while others come from extended scientific research.

Besides all these more or less routine matters enumerated, there are scores of problems popping up from day to day. Why does the worsted yarn dye so unlevel when everything is apparently just as it should be? Where do the stains come from that are only just showing up now that the goods are nearly finished? What is a competing shirting printed with? What caused the unusual boiler scale? Why does a certain pipe line rust out quickly when the one next to it lasts three times as long? Last, but by no means least, are the problems of removing ink spots from the office girls' waists and telling the boss what the latest nostrum is made of, which he has just bought to double the mileage from his gasoline.

In making our rather broad claims we shall have to be fair and admit that there are many *mechanical* features and problems in our industry, or we may be taken to task by the active Textile Section of the American Society of Mechanical Engineers. Granting this, however, and remembering that we have scarcely touched on many chemical operations like carbonizing, neutralizing, and the many complex varieties of dyeing—have we not made a fair case for textiles as a chemical industry?

Bright Colors and Tints on Carpet and Rug Yarns

Bright, Clear Shades in Demand—Tint Dyeing in a Class by Itself—Formulas Should Be Rigidly Followed —Care Needed in Preparation of Yarns—Various Precautions for Avoiding Dulled Colors— Advisable to Follow Goods Through After Match Is Made

By FRANK C. HOLDEN

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TO-DAY we speak of carpet mills and carpet yarns when in reality we should say rug mills and rug yarns. To be sure, there is a great quantity of carpet, both in all-over and stair effects, still in demand, principally for hotels, public buildings, Pullman cars, motor cars, etc., but the general householder demands rugs and it is the householder that eventually buys the greater portion of the yardage produced in carpet mills, so called.

Rugs as a rule call for more colorful effects than carpeting, and it is surprising what a large quantity of very light, brightly tinted yarns are used in their production. Invariably the colorist will resort to the use of bright tints to give life and snap to a pattern; and although in the individual pattern only a small percentage of the figure may be filled in with tints, yet in the aggregate the requirements of such colors run into a very considerable poundage.

The dyeing of bright colors and tints naturally calls for extreme care in the preparation of the yarn and dye bath. The yarn should be of the cleanest quality available for the purpose for which it is used. Scouring is carried out in the usual manner, using either a skein, endless apron scouring machine, or wash boxes fitted up with squeeze rolls. The scouring agent generally adopted is the combination of soap and soda ash, the quantities used depending largely on the condition of the yarn. The heat of the scouring bath should be closely watched and should not exceed 110 deg. Fahr. Excessive heat causes the fibers to felt, and if mineral oil is present it may become set in the fiber rather than washed out. From the scouring machine the well-washed yarn is either carried to a

stoving room for bleaching or is bleached in open tubs with bisulphite of soda with the addition of oil of vitriol. The latter bleach gives a very clean yarn which is suitable as a ground for bright and fairly light colorings. For delicate tints, however, a clearer, more nearly white ground is necessary, and this condition is produced by subjecting the damp yarn to the fumes of sulphur dioxide. A full bleach is generally developed during a period of from ten to twelve hours. The yarn is then given a thorough wash to eliminate sulphur fumes. For pure whites the yarn is given a bluing bath, sometimes with the addition of blanc fixe or chalk, which helps to give a clearer ground. These whiting additions are merely fixed mechanically in the fibers.

Avoidance of Dulled Effects

Before proceeding to dye the previously prepared yarn, considerable caution must be observed in the preparation of the dye bath. Experience has taught the dyer that certain conditions interfere with the production of clear, bright colors. For instance, a preponderance of metal in the dye bath will have a dulling effect. To overcome this condition, open wooden tubs are found to work to advantage. In the same way hard or continued boiling will knock down a bright color, and so it is advisable to work with small batches—say, of 100 pounds each—which may be readily manipulated. Full quantities of Glauber salt are also harmful, and rather than use Glauber salt and vitriol, which is the general custom for carpet yarn dyeing, it is preferable to use acetic acid with but a very small addition of leveling salt. And naturally, since the requirements call for bright colors, only such dyestuffs as will give clean, bright dyeings should be used. Certain acid colors have proven to be quite satisfactory for carpet requirements, and it is with this class of dyestuffs that practically all woolen and worsted carpet yarns are dyed. Combinations of dyestuffs tend to have a dulling effect, and whenever possible self-colors—or, in other words, straight unmixed dyestuffs—should be used. At least the dyer should hold his formulas down to as few intermixtures of dyestuffs as possible, which no doubt is a good policy to follow in general dyeing. The writer dislikes to use more than three dyestuffs in the production of a color, but at times, from the point of view of economy, it is advisable to use more.

Producing a Clear Match and Following Through

Water which is freshly drawn into a dye tub invariably contains mechanical impurities and certain organic matter which works against the dyestuff when bright tints are desired. To clarify and brighten the liquor it is necessary to run a batch of clean yarn through it, having previously added to the bath a small amount of acetic acid and some of the dyestuff which is to be subsequently used to produce the required color. The bath is heated to about 150 deg. Fahr. and the yarn worked through it for fifteen minutes. In some cases it is often necessary to repeat this operation before the liquor is sufficiently clean. The bath is then made up with the required amount of dyestuff, acetic acid and salt, and the yarn entered. It is given three quick turns, the steam then turned on and the liquor gradually brought to just under a boil. After forty-five minutes' working the batch is ready for sampling. If the dyer can produce the required match with but one or two additions of dyestuff, a clean, bright color should result. On the other hand, if he finds it necessary to make many additions before arriving at the fulness of tone required, the result generally lacks brightness and a new start must be made. When the expense and care of preparing the batch is considered, the necessity of throwing out a batch is most undesirable. It is advisable to work tint formulas up to the full match and take as many batches from the enter as possible. To do this, extreme care must be taken in weighing the batch, measuring and clarifying the dye liquor, weighing and dissolving the dyestuff, and controlling the time and temperature of dyeing. And after all this caution is exercised and the sample is pronounced a good match it is just as necessary to follow the batch through and see that the extracting and drying processes are followed out along standardized lines. It is extremely aggravating to follow the previous procedure and produce a good clear match from the kettle, only to find the clearness gone and a dull coloring the final result, due to some unknown condition developing between the dye kettle and the take-off end of the dryer.

Overcoming Unevenness

Inasmuch as the tint dyeing is made just under a boil and with as little leveling salt as possible, there is a tendency for unevenness with some dyestuffs. This tendency may be overcome to a great extent by well extracting the yarn just previous to dyeing. From the extractor the yarn is uniformly damp throughout and in a somewhat absorbent condition. Naturally the dye liquor is readily distributed through the yarn without the necessity of displacing or gradually consuming the wash liquor which was applied during the scouring process.

Generally speaking, tint dyeing should be considered in a class by itself and not carried along with the regular run of work during any one of the various processes. It is safe to say that in the general run of dyeing the dyer may make small mistakes here and there and successfully cover them up. In dyeing tints, however, he must follow the straight line of standardized processing most rigidly for practical results, as a mistake, however slight, means that a new start must be made.

MORDANTS

In Three Parts—Part II

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Note—References will be found at the conclusion of this installment, p. 214

ALUMINA

Hydrolysis of Aluminum Salts

OVER a century ago, Gay-Lussac[1] found that if one heats a solution of aluminum acetate, it soon becomes turbid and a large amount of alumina precipitates. If the solution is allowed to cool, the precipitate dissolves slowly and becomes transparent. On the reheating and recooling these changes repeat themselves and this can be kept up indefinitely. With a dilute solution of aluminum acetate the turbidity begins at about 50 deg. and a precipitate forms at a little higher temperature. The precipitate must change gradually because it dissolves more slowly, when the solution is cooled, the longer the heating has lasted. With a more concentrated solution of aluminum acetate the temperature must be raised somewhat higher before turbidity occurs; but this solution also clears up when cooled.

"To determine the amount of alumina precipitated from an acetate solution by heating and the variation with the temperature, there were taken two equal portions of aluminum acetate made by mixing in the cold two solutions of alum and of lead acetate. One of these portions was raised to the boiling-point and filtered at once, while the other portion was precipitated by ammonia. The two precipitates were washed and dried; after which it appeared that the first weighed about half as much as the second.

"These observations may be very important for the makers of dyed fabrics for they use the hot solutions of alum and lead acetate in order to get as concentrated solutions of the mordant as possible. A great deal of alumina must precipitate, and the loss will be considerable if the solution is filtered at once. To avoid this it is necessary to let the solution cool completely before filtering or decanting off the mother liquor, and it is also necessary to stir vigorously so as to be certain that all the alumina redissolves. Unless these precautions are taken, the aluminum acetate will be very acid, which is probably the reason for usually adding chalk. It is nevertheless easy to prevent the precipitation of alumina when an aluminum acetate solution is heated, by adding alum. As is well known, alum dissolves alumina and therefore keeps the solution of aluminum acetate from becoming turbid. A large excess of acid will accomplish the same result.

"The precipitation of alumina on boiling and the redissolving at a lower temperature are facts which are of interest to the general theory of chemistry and which are rather exceptional. If the precipitation were due to volatilization of the acetic acid, the alumina would not redissolve when the temperature is lowered. As a matter of fact similar changes can be observed in a strongly acid solution or in hermetically sealed flasks. Since the precipitation does not depend on the volatilization of the acid, it is evident that it is due to the heat which wrenches apart the molecules of acid and alumina, carrying each out of the sphere of action of the other, and causing their separation. With less heat the same molecules come within each other's sphere of activity and combine."

Gay-Lussac is practically saying in other words what we now designate as reversible hydrolysis. In 1854 Crum[2] prepared colloidal alumina from a weaker and more basic solution than that used by Gay-Lussac. "By the continued action of heat on a weak solution of binacetate of alumina, $Al_2O_3(CH_3CO_2)_4(OH)_2$, a permanent separation of the constituents of the salt takes place, although no acid escapes and no alumina is precipitated. The properties of the alumina are at the same time materially changed. A solution of binacetate of alumina diluted so as to contain not more than one part of alumina in two hundred of water, was placed in a closed vessel which was immersed to the neck in boiling water, and kept in that state day and night for ten days. It had then nearly lost the astringent taste of alum, and acquired the taste of acetic acid. Being afterwards boiled in an open capsule, acetic acid was freely given off, and when the boiling had continued about five hours (the loss of water being continually restored), the liquid was found to have retained not more than one-eleventh of its original quantity of acetic acid, or about one equivalent to five and a half of alumina."

The theory of this is very simple. Water will hydrolyze any salt until the product of the concentrations of the hydrogen and hydroxyl ions reaches a value of about 10^{-14}. If either base or acid is very sparingly soluble, the hydrolysis will run farther than if both are strong electrolytes. Equilibrium will be reached much more rapidly if the solution is heated. Whether the insoluble base precipitates or remains in colloidal solution will depend on the conditions of the experiment. That hydrolysis has taken place can be shown in a number of different ways. Gay-Lussac deduced it from seeing the pre-

cipitated alumina and Crum from the change in the taste of the solution. One could measure the change in acidity in other ways than by the sense of taste. Debray[3] showed that if a dilute solution of ferric chloride is heated to 70° it no longer reacts with potassium ferrocyanide to form Prussian blue. The reason for this is that there is no more ferric salt in solution, it having been converted completely into colloidal ferric oxide. Colloidal ferric oxide is not blackened by hydrogen sulphide. On the other hand it is precipitated from apparent solution either by sodium sulphate or by sulphuric acid, a behavior which is distinctly not characteristic of ferric chloride. Wiedemann[4] has used the magnetic properties as a means of following the hydrolysis, because the atomic magnetism of the iron in colloidal ferric oxide is only one-fifth that of the iron in a strongly acid solution of ferric chloride. Colloidal solutions of the hydrous oxides can be obtained by hydrolysis of the acetates, nitrates, or chlorides; but not in general by hydrolysis of sulphates, because sulphuric acid precipitates the colloidal solutions more readily than does hydrochloric, nitric, or acetic acid.

In 1883 Liechti and Suida published some work on the hydrolysis of solutions of aluminum salts. Their original paper is not in the John Crerar Library, the Library of Congress, or the Library of the Franklin Institute. I have therefore made use of the lengthy abstract by J. J. Hummel.[5] With aluminum sulphate ($Al(SO_4)_3.18H_2O$, 200 g per liter) there was no visible hydrolysis on heating or on diluting. With $Al_2(SO_4)_2(OH)_2$ made from 200 g $Al_2(SO_4)_3.18H_2O$ + 31.82 g Na_2CO_3 per liter, there was no visible change on heating; but a precipitate formed when the solution was diluted fourteenfold. With a solution three-quarters as concentrated, there was no visible change on heating, but dissociation took place on diluting tenfold. Since three-fourths of fourteen is ten and a half, this shows the error in determining the beginning of visible hydrolysis. With $Al_4(SO_4)_3(OH)_6$, made from 200 g $Al_2(SO_4)_3.18H_2O$ + 45.7 g $NaHCO_3$ per liter a jelly was formed on heating and a precipitate remained on cooling. Diluting to one-half caused a precipitate to appear in the cold. With $Al_2(SO_4)(OH)_4$, made from 300 g $Al_2(SO_4)_3.18H_2O$ + 151.3 g $NaHCO_3$ per liter, the solution kept only a short time. The general results are that hydrolysis takes place more readily on heating and on diluting, the more basic the solutions. The statement is made that sodium sulphate accelerates the dissociation. If this is true, it must be because the sodium sulphate decreases the hydrogen ion concentration by reacting with the sulphuric acid to form acid sodium sulphate. Since sodium sulphate coagulates colloidal alumina, it may be that it has practically no effect on the hydrolysis; but causes the precipitate to become visible sooner. In other places Liechti and Schwitzer[6] say that they have proved that sodium sulphate retards the decomposition. There must be a misprint somewhere. A retarding of the decomposition would be more in line with the observation by Schmid[7] that sodium sulphate retards the precipitation of alumina by sodium carbonate.

With what they call a sulpho-acetate, $Al_2(SO_4)(CH_3CO_2)_4$, made from 200 g $Al_2(SO_4)_3.18H_2O$ + 227.6 g $Pb(CH_3CO_2)_2$ per liter, a precipitate formed on heating to 90° and a jelly on heating to 100°. The solution cleared up on cooling. There was no precipitate on diluting sixtyfold. On adding sodium bicarbonate to this so-called sulpho-acetate, Liechti and Suida obtained solutions of what they called basic sulpho-acetates, from $Al_2(SO_4)(CH_3CO_2)_3(OH)$ down to $Al_2(SO_4)(CH_3CO_2)(OH)_3$. There is no real reason for assigning these formulas to these solutions. In the first place there is no obvious reason why the sodium bicarbonate should take acetate rather than sulphate out of the aluminum salt. It would be distinctly more reasonable to consider the basic compounds as varying from $Al_4(SO_4)(CH_3CO_2)_4(OH)_2$ to $Al_2(CH_3CO_2)_3(OH)_3$. Probably the reason for not doing this was that these solutions did not behave like basic acetate solutions obtained by adding sodium bicarbonate to aluminum acetate; but that does not prove anything because these latter solutions do not contain sodium sulphate. In the second place there is no reason to suppose that Liechti and Suida ever had a sulpho-acetate solution. The so-called sulpho-acetate solution was undoubtedly merely a mixture of 1/3 $Al_2(SO_4)_3$ and 2/3 $Al_2(CH_3CO_2)_6$. Similarly there is no satisfactory evidence of the existence of any of the alleged basic compounds. They may perfectly well have been aluminum sulphate or aluminum acetate or a varying mixture of both with peptized alumina. Liechti and Suida undoubtedly thought they were dealing with true basic salts because of their getting an apparent solution; but it is quite evident even from the abstract that they knew nothing about colloidal solutions. The formulas which are written therefore indicate the relative amounts of sodium bicarbonate which have been added to the original solution and nothing more than that. This point seems to have been overlooked by all the people who have discussed this work.

The so-called basic sulpho-acetates all formed jellies on heating and all formed precipitates on dilution, the temperature at which the first turbidity occurred being lower the more basic the solution. Less water had to be added to cause precipitation as the solution became more basic. With straight aluminum acetate, made from 200 g $Al_2(SO_4)_3.18H_2O$ + 341.4 g $Pb(CH_3CO_2)_2$ per liter, there was no turbidity on heating and no precipitation on cooling. This result does not contradict that of Gay-Lussac because he was working with a more dilute solution. All the so-called basic aluminum acetates formed precipitates or jellies on heating which did not dissolve when the solutions were cooled. The one with the alleged formula $Al_2(CH_3O_2)_4(OH)_2$ precipitated on dilution; but the more basic ones did not. This may only be a question of a time factor. If not, sodium acetate must peptize alumina strongly.

By adding sodium carbonate to aluminum chloride, solutions were obtained having the analytical compositions, $Al_2Cl_5(OH)$, $Al_2Cl_4(OH)_2$, $Al_2Cl_3(OH)_3$, $Al_2Cl_2(OH)_4$. None of these solutions become turbid either on heating or on diluting. Liechti and Suida were not able, however, to make these alleged solutions synthetically. "The solubility of aluminum hydrate in aluminum chloride was tested, and the following remarkable results were obtained. To a solution of Al_2Cl_6 a quantity of aluminum hydrate was added sufficient to form the basic salt $Al_2Cl_4(OH)_2$. The alumina dissolved only on heating and the solution remained clear on cooling. To this clear solution a further quantity of aluminum hydrate was added sufficient to form the compound $Al_2Cl_2(OH)_4$. It was, however, found that no more alumina could be made to dissolve, the precipitate even increasing, and on filtering it was found that the solution contained equal molecules of normal Al_2Cl_6 and of HCl. The nascent $Al_2Cl_2(OH)_4$ had apparently decomposed according to the following formula:

$$7\ Al_2Cl_2(OH)_4 + 2\ H_2O = 5\ Al_2(OH)_6 + 2\ Al_2Cl_6 + HCl.$$

In the same way it was proved that, on adding aluminum hydrate to $Al_2(SO_4)_3$ solution sufficient to produce the basic compound $Al_4(SO_4)_3(OH)_6$, no alumina at all dissolved, the filtrate only containing $Al_2(SO_4)_3$. Here, too, we must suppose that the nascent basic compound decomposes as follows:

$$Al_4(SO_4)_3(OH)_6 = Al_2(OH)_6 + Al_2(SO_4)_3."$$

We know that hydrous ferric oxide, if present in excess, will remove from suspension all the chromic oxide[8] peptized by caustic alkali; but nobody has studied the removal from suspension of a substance by an excess of itself, unless perhaps we have such a case in the Bayer process for the purification of alumina. Since Liechti and Suida were obsessed with the idea of basic compounds, they made no experiments to see whether addition of sodium chloride would cause more alumina to go into apparent solution. According to Schmid[9] sodium sulphate retards the precipitation of alumina.

A whole series of so-called basic nitrate solutions were made up by adding sodium bicarbonate to aluminum nitrate solutions. None of these solutions became turbid either on heating or on dilution. The sum total of all these experiments is that basic aluminum acetate solutions hydrolyze very readily because the resulting acetic acid is a weak acid; that basic aluminum sulphate solutions become turbid because of the coagulating action of the sulphates, this more than counterbalancing the effect due to the strength of sulphuric acid; and that basic aluminum chlorides and nitrates do not become markedly turbid because the acids are strong ones having low coagulating powers.

Although Liechti and Suida got no cloudiness with their aluminum sulphate solution on heating, that may have been a question of concentration or of time for Naumann[10] reports that "when a solution of potash alum is heated to the boiling point of water, a white precipitate is formed, which, after washing with water, is an amorphous powder, with an admixture of glittering laminae, and dissolves with difficulty in strong hydrochloric acid, but easily in potash. The precipitate contains 31.2-32.6 percent of alumina, about 11 percent of potash, 30-40 percent of sulphuric acid, and water; and is therefore a more or less basic compound of alumina, potash, and sulphuric acid, with water. It was found that with pure alum solutions the decomposition was most rapid at first, gradually becoming less for equal intervals of time, so that a state of equilibrium in the liquid was reached only after a very long time. Dilution of the solutions favored decomposition. Free sulphuric acid, added to alum solutions, prevented the decomposition, partially or entirely, according to the amount added. Neutral potassium sulphate, on the contrary, expedited the decomposition."

There is a good deal of uncertainty as to what compounds are formed when salts of aluminum are boiled or are treated with soda. Cajar[11] states that the action of soda on cold aluminum sulphate solution gives a white precipitate which covers well; whereas a more transparent precipitate is obtained when the soda is added to a hot sulphate solution. Underwood[12] states that alumina precipitated cold with sodium carbonate contains basic sulphate and dries soft and powdery; but that it dries horny when precipitated hot. Jennison[13] says that the hydrate of aluminum, $Al_2(OH)_6$, "is produced when caustic soda or potash, ammonium hydrate or carbonated alkalies is added to a solution of an aluminum salt; it is soluble in caustic alkalies, and therefore is usually obtained by means of the carbonates. When produced from cold, dilute solutions, it is of a transparent, gelatinous nature; but, on heating, becomes opaque and more contracted in bulk. With carbonated alkalies it is much denser and is very lumpy, owing to the reaction being incomplete. Aluminum hydrate when dried, forms a hard, white, horny substance, which has the composition of $Al_2(OH)_6$, and only on ignition is the whole of the water driven off, leaving Al_2O_3."

According to Knecht, Rawson and Loewenthal[14] a crystallized basic sulphate, $Al_2(SO_4)_2(OH)_2$, has been placed on the market by Messrs. Peter Spence and Co., Ltd. Schlumberger[15] claims that there is one basic sulphate of aluminum. On adding 4.5 mols of caustic potash to a solution containing one mol of aluminum sulphate, the supernatant liquid was still distinctly acid. On adding 5 mols KOH the solution was neutral and contained no aluminum salt. On adding 6 mols KOH the supernatant liquid was alkaline and contained some alumina, presumably as potassium aluminate. The precipitate must therefore analyze for $(Al_2O_3)_2SO_3xH_2O$ where x is not less than six. Actually it came out seven, so

Schlumberger writes the formula of the basic salt $(Al_2O_6H_6)_2.H_2SO_4$. Of course, it will be noticed that he analyzed a precipitate obtained only under one set of conditions. While it may be that he was dealing with a definite compound, there is nothing in his experiments to prove it. He should have analyzed the precipitate after adding three or four mols of caustic potash and have shown that it had exactly the same composition. Then his results could have been accepted as proving something. This is the more necessary because many basic aluminum sulphates are to be found in the books.[16] Bottinger contributes a new one of his own by evaporating repeatedly to dryness a mixture of aluminum sulphate and sodium chloride at 130°-140°. This one analyzes for $Al_2O_3.SO_3.6H_2O$ or $Al_2O_6H_6.H_2SO_4.2H_2O$ if we adopt Schlumberger's way of writing the formula.

Adsorption of Aluminum Sulphate by Wool

Since the different salts of aluminum hydrolyze of themselves under suitable conditions, they should hydrolyze even more readily in presence of a textile fiber which adsorbs the alumina and they do as a matter of fact. In so far as the acid radical is also adsorbed, there may be minor complications and the matter may seem less simple than it really is.

When wool is treated with aluminum sulphate, $Al_2(SO_4)_3.18H_2O$, less than about five percent on the wool, the bath is exhausted completely, all the alumina and all the sulphuric acid being taken up.[17] With higher concentrations, more and more aluminum sulphate is left in the bath. There has been some discussion whether the wool takes up aluminum sulphate or alumina and sulphuric acid in the cases when the bath is exhausted completely. When wool mordanted in this way is boiled with water, the wash water is always acid, sulphuric acid being removed slowly and alumina left behind. This has been considered by von Georgievics[18] as a proof that the sulphuric acid is free. While this may be true, it does not follow, because the adsorbed aluminum sulphate might be hydrolyzing. It is much wiser to admit frankly that we have no way at present of deciding this point. In case the acid is not combined in definite proportions, the next problem is whether it is adsorbed by the alumina, by the wool, or by the two in some unspecified ratio.

TABLE I

25.4% sulphuric acid in potash alum.

Potash alum referred to wool	Sulphuric acid referred to potash alum		Sulphuric acid referred to wool	
Concentration percent	Wool percent	Solution percent	Wool percent	Solution percent
5	25.4	0.0	1.27	0.0
10	22.1	3.3	2.21	0.3
15	14.6	10.8	2.19	1.6
20	11.0	14.4	2.20	2.9

Ganswindt[19] gives some data by Furstenhagen and Appleyard[20] on the mordanting of wool by potash alum, which are reproduced and extended in Table I.

In the first column are the amounts of potash alum referred to the weight of wool. In the second and third columns are the percentages of sulphuric acid in the total amount of alum in the wool and the bath respectively. At 5% alum all the sulphate is taken up, but with higher concentrations of alum more of the sulphuric acid stays in the bath. Since determinations on the alumina adsorption are not given, we cannot tell to what extent alumina is adsorbed more than sulphuric acid. Since this method of presentation is not the usual one, I have added two columns to show the percentage of sulphuric acid referred to wool, taken up by the wool and left in the bath respectively. If these figures are to be trusted, the amount of sulphate adsorbed by the wool is practically constant when the bath contains 10%-20% alum referred to the wool. It is probable that this is not strictly true.

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(To be continued.)

The Chemical Division of the U. S. Department of Commerce will be represented at the 1922 Chemical Exposition at the Grand Central Palace this year, along with the Bureau of Mines and the Bureau of Chemistry. C. R. Long, of the Department of Commerce, will speak on September 12, at 8 o'clock, on "How the Department of Commerce Can Serve the Chemical Industry."

The Standardization Program of the 1922 Chemical Exposition, composed of a number of addresses on standardization by well-known authorities, will be held on Friday, September 15, under the direction of the New York Section of the American Chemical Societry. Dr. Martin H. Ittner will act as chairman.

Naphthol AS and BS and Their Use in the Dyeing of Cotton Warps

Origin of These Products—Properties—Simplicity and Ease of Application—Elimination of Drying Makes for Economy—Various Shades Produced on Warp Yarns—Method of Washing—Ingredients of Starting Baths for 500-lb. Warp Runs for Red, Orange, Garnet, Pink and Dark Blue

By MERRILL G. MORRIS, B.T.C.

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IN 1913 the Chemische Fabrik Griesheim Elektron produced and put upon the market two products closely related to beta naphthol, which were known as Naphthol AS and Naphthol AN. Owing to trade conditions which followed the outbreak of hostilities in Europe, very little attempt was made on the part of the discoverers to put their two new products upon the American market. There resulted, therefore, a loss of interest along this line until these products began to reappear in America, though on a very small scale, in 1919. Their manufacture was then taken up by the leading American dyestuffs concerns, which have succeeded in putting upon the market very pure, high-grade samples of these two products, equal in every respect to the pre-war imports.

Properties of Naphthol AS and BS

The first of the two to make its appearance was Naphthol AS. It is sold as a finely ground grayish powder, soluble in caustic alkalies, insoluble in water, and having a melting point of 243 deg. Cent. It is known chemically as beta-oxynaphthoic-acid-anilid. Naphthol AN closely followed Naphthol AS, and is now known as Naphthol BS. It is sold as a finely ground yellowish powder, soluble in caustic alkalies, insoluble in water, and having a melting point of 233 deg. Cent. It is known chemically as beta-oxynaphthoic-acid-metanitranilid.

These naphthols may be used in the dyeing of piece goods, raw stock and yarn, giving a variety of shades excepting yellow and green. They are used in the same general way that beta naphthol is used; that is, by impregnating the goods with the naphthol solution, removing the excess naphthol solution and drying, and passing the prepared goods through a developing solution which is the diazotized solution of an aromatic amine. They may, however, be used to far greater advantage than beta naphthol, and give much better results both in working qualities and in excellence of finished product. The dyeings produced by coupling Naphthol AS or BS with different aromatic amines are far superior in brilliancy and in practically every point of fastness when compared with dyeings produced from beta naphthol. In fact, they equal and even surpass some of the vat colors in this respect. In working with Naphthol AS and BS it will be found generally that dyeings produced with Naphthol BS give bluer shades than those produced with Naphthol AS. A notable example of this will be found in the case of Fast Scarlet G Base, where goods prepared with Naphthol AS give very yellowish pinks, while goods prepared with Naphthol BS give very bluish pinks. Thereby we may produce at will many different shades simply by mixing the two naphthols in different proportions when preparing. In using beta naphthol the only method of producing mixed tones was by mixing two or more diazo solutions. This method, however, would never produce as uniform and as satisfactory results as are produced by the use of both Naphthol AS and BS in the preparing solution. Unlike beta naphthol, both Naphthol AS and BS may be saved for further use from a standing bath without suffering any deterioration or loss of strength. They may, however, become clouded, due to a slight separation of the naphthol, but only after standing several days. This separation or precipitate may be redissolved by the addition of some caustic soda solution of 30 deg. Be. and a little castor oil soap.

Elimination of Drying Makes for Economy

Naphthol AS and BS have the property of dyeing the fiber, and consequently exhaust the bath to a greater degree than does beta naphthol. This property is of great advantage, for in many cases, on certain classes of goods, it eliminates the necessity for drying between the preparing and developing operations. Warps and raw stock, and yarn on cops, cheeses, etc., for package dyeing, need not be dried, as mentioned above. They simply need to have a rather thorough extraction after impregnating with the naphthol solution. This may be done in the case of warps by a good pressure at the squeeze rolls, on raw stock by a good whizzing, and in package apparatus by whizzing or suction. By the elimination of the drying operation these naphthols introduce a large economy in labor costs and steam consumption, in addition to the saving of valuable time.

Piece goods should be dried unless the use of a hydraulic mangle can be employed, as they cannot be devel-

oped satisfactorily unless 70 to 80 per cent of the impregnating naphthol solution be removed. In case goods must be dried, the temperature should be kept below 170 deg. Fahr. and carried out as promptly as possible. Drying in a hot flue is said to be preferable to can drying, but with care it will be found that cans may be satisfactorily employed.

Various Shades Produced on Warp Yarns

There are several shades which may be produced with great ease and satisfaction on warp yarns and at a great saving. Among the more important ones are red, orange, garnet, pink and blue. The red, orange and garnet are to be used in full tones only, for medium tones do not turn out to be satisfactory except in very few cases. Blues may be dyed in any depth, from light greenish blue up to the heaviest navy blue, simply by increasing the strength of the prepare. Pinks may be dyed from the weakest flesh tones up to the brightest scarlet simply by increasing the strength of the prepare. At the same time the pinks may be given a bluish or yellowish cast according to the proportions of Naphthol AS and BS present in the prepare, thereby giving an unlimited number of possibilities.

The above-mentioned colors may all be prepared and developed in one run on an ordinary three-box warp-dyeing machine, the first box to be used for impregnating with the naphthol solution, the second box for developing with the diazotized amine, and the third box for rinsing in cold running water, if dyeing red, orange, garnet or pink. When dyeing red, orange and garnet, the prepared and developed warp may pass directly to the third box. For pinks a run of from one to two minutes on skying or overhead rollers should follow the second box and precede the third or rinse box. Fast Scarlet R Base, usually used for pinks, is a little slow in development, and a short interval between coupling and rinsing allows ample time for the complete formation of the colored body. For blues the third box should be left dry and the cold rinse carried out in an extra run. Fast Blue B Base is very slow in development and skying rollers will not answer as in the case of the pink.

Method of Working

After threading the machine, the naphthol prepare, properly dissolved, is run into the first box of the warp-dyeing machine, made to the proper volume and heated to about 80 deg. Fahr. There must be at least enough preparing solution to cover the bottom rolls before starting, thus allowing ample room for the feeding solution to be added later on.

The developing solution, properly diazotized and neutralized so as to be devoid of any free mineral acid, is run into the second box through a sieve or fine cotton cloth. It is absolutely essential that the developing solution be filtered in the case of Fast Red G Base and Fast Garnet G Base, and it is very desirable that it be done with the other developers. The addition of some finely cracked ice from time to time during the run is advisable, inasmuch as it keeps the temperature of the developing bath low. Otherwise the entrance of the warm warp yarn would have a tendency to raise the temperature of the developing bath, thereby eventually destroying it.

The third or rinse box is filled with cold running water (except when dyeing blues), and the machine is ready to run.

During the run the original strength of both preparing and developing liquors must be maintained by feed solutions to procure uniform results. These feeding solutions must be made up considerably stronger than the starting baths and should be added in the exact amounts at regular, consecutive intervals. Care must be exercised especially in the case of the preparing liquor, for any carelessness in the addition at this point shows up after dyeing.

The prepare feed liquor should be made up 20 per cent stronger than the starting bath if dry yarn is used, and about 50 per cent stronger if wet yarn is used. It should be fed on at the rate of about 2 gallons for every 150 yards of warp in the examples given below.

The developing feed liquor should be made up three times as strong as the starting bath, and should be added at the same rate as the prepare feed liquor in the examples given below.

By the above-outlined process it will be found that dyeings on warp yarns of excellent general fastness may be had in one run. After the dyeing the yarn should be given one run in hot water and then soaped in two runs. The soaping should be carried out in a two-box machine, the first of which contains a 3 per cent soap solution and the second clear hot water. In exceptional cases soda ash may be added to the soaping baths, but it is inadvisable as a rule. If used at all it should be only in small quantities. The best temperatures for soaping vary with the different colors and will be found stated below in the separate directions for each color. A final treatment with olive oil emulsion is of advantage in that it improves the handle and working qualities of the warps considerably and may be accomplished in one run.

Below are given the quantities of ingredients which are required for the starting bath of a run of 500 pounds of warp 4,000 yards in length. In any case where the amounts stated do not give a great enough volume to cover the bottom rolls of a machine, more of the solution must be made up in the same proportions. It is only essential that the strength of the solution be maintained, the volume being relatively unimportant.

Red

Prepare—Prepare the warp with a solution made up in the following proportions:

Naphthol AS	12.00 lb.
Castor oil soap	24.00 lb.
Caustic soda, 30 deg. Be.	24.00 lb.
Boiling water	24.00 gal.
	100.00 gal.

Add the castor oil soap, which is an important penetrating and leveling agent, to the naphthol. Stir to a smooth paste, being careful to see that all lumps are well broken. Then add the caustic soda solution; stir a few moments till the whole is well mixed, and pour over it the boiling water. Stir well, and complete solution should take place immediately. In case of any difficulty in dissolving, bring the solution to a boil. Make the volume up to 100 gallons with cold or warm water so that it stands ready for use at 80 deg. Fahr. If it is to be kept twenty-four hours or longer, add 5 pints of formaldehyde 40 per cent solution.

Developer—

Fast Red G Base	6.25 lb.
Hydrochloric acid 37 per cent	18.80 lb.
Boiling water	1.00 gal.

Allow the above to stand at least thirty minutes and pour over:

Ice	40.00 lb.
In water	12.00 gal.

and bring the temperature to 55 deg. Fahr. Add slowly and in solution:

Nitrite of soda	3.50 lb.

and then also in solution:

Aluminum sulphate	8.00 lb.

Allow to stand for thirty minutes and then add very slowly:

Precipitated chalk suspended in water	4.50 lb.
	100.00 gal.

Make to 100 gallons with cold or warm water so that it stands ready to use at 55 deg. Fahr. At this point the liquor should show no trace of free mineral acid present, but in any event chalk pasted with water should be added till after the evolution of carbon dioxide gas ceases.

Prepare and develop in one run and rinse once at 160 deg. Fahr. Soap twice at a boil and finish off with one run in olive oil emulsion. The color produced by this method is equal in all respects to the old turkey red and is far superior to para red in all respects. It withstands washing, bleaching, kier boiling and cross-dyeing perfectly, and is of supreme fastness to light.

Orange

Prepare—Same as for the red.

Developer—

Fast Orange R Base	6.25 lb.
Hydrochloric acid 37 per cent	17.00 lb.
Boiling water	1.00 gal.

Pour the above quickly over:

Ice	30.00 lb.
In cold water	12.00 gal.

and add quickly with stirring:

Nitrite of soda in solution	3.40 lb.
	100.00 gal.

Just before use add 20 pounds acetate of soda in solution.

Prepare and develop in one run as with the red, being sure that the temperature of the developing bath does not exceed 40 deg. Fahr. Soap at 140 deg. Fahr. in two runs and finish off in a final run through olive oil emulsion. The range thus produced is of the same shade as beta-naphthol orange, but is far superior in fastness, closely approximating Thio Indigo Orange R in its resistance to all color-destroying agencies.

Garnet

Prepare—Same as for the red.

Developer—

Fast Garnet G Base	7.00 lb.
Hydrochloric acid 37 per cent	12.00 lb.
Boiling water	1.00 gal

Pour the above over:

Ice	40.00 lb.
In water	12.00 gal.

and add slowly and in solution:

Nitrite of soda	1.25 gal.
	100.00 gal.

Just before use add 15 pounds acetate of soda in solution.

Prepare and develop in one run, as with the red; rinse once at 160 deg. Fahr. and soap twice at the boil. The garnet produced in this manner is of a very rich tone, being far brighter and richer than alpha-naphthylamine claret and excelling the latter in fastness to chlorine, cross-dyeing, crabbing, steaming and sunlight. It is far superior to any diazotized and developed colors of the same shade for warps in both cost and fastness considerations.

Pink

Prepare—

Naphthol AS	20.00 gm.
Caustic soda solution 30 deg. Be	40.00 c.c.
Castor oil soap	60.00 gm.
Boiling water	60.00 c.c.
	100.00 gal.

Developer—

Fast Scarlet R Base	6.25 lb.
Boiling water	4.00 gal.
Hydrochloric acid 37 per cent	10.50 lb.

Boil the above and pour over:

Water	12.00 gal.
Ice	40.00 lb.
Aluminum sulphate	4.5 lb.

Then add slowly in solution:

Nitrite of soda	1.25 lb.
Aluminum sulphate	4.50 lb.
	100.00 gal.

Just before use add 12 pounds acetate of soda in solution.

Prepare and develop in the usual manner, but allow the dyed warp to pass over a set of overhead rollers before it goes into the rinse box. In order to obtain satisfactory, uniform results with such a light shade as the one outlined above, it is especially important that the feed liquor be added regularly and carefully. The dyed warp should be given one rinse at 160 deg. Fahr. and soaped twice at that temperature, after which should follow the usual olive oil treatment. The fastness properties of this color approach but do not quite equal those of Helindone Pink.

Dark Blue

Prepare—Same as for the red.

Developer—

Fast Blue B Base	1.75 lb.
Boiling water	5.00 qt.
Hydrochloric acid 37 per cent	1.30 lb.

Pour the above over:

Ice	30.00 lb.
In water	12.00 gal.

and add:

Hydrochloric acid 37 per cent	1.00 lb.

Then add slowly:

Nitrite of soda	0.75 lb.
	100.00 gal.

Just before use add 10 pounds acetate of soda in solution.

Make up to 100 gallons with water warm enough to raise the temperature to 80 deg. Fahr. and develop at that temperature in the usual way. No water should be allowed to touch the warp till at least fifteen minutes after passing through the developing bath. The first cold rinse must come in a separate run and should be followed by a boiling hot rinse. Then soap twice at the boil with the addition of 1 per cent of soda ash and after-treat in a bath made up of:

Bichromate of soda	1.5%
Copper sulphate	3.0%
Acetic acid	3.0%

The olive oil treatment may now follow and the dyeing is completed.

The first method for dyeing blues of this type was brought out about twenty-five years ago for use in conjunction with beta naphthol, and included the addition of cupric chloride and chromic acid straight to the developing bath. The results to be obtained by that method were uncertain and at best were inferior in tone and strength to those which are coppered after the dyeing.

The blues which are after-treated with copper, chrome and acetic acid are by far the most interesting development to date in connection with the Naphthol AS series of coloring matters. By this method a dianisidine blue of great commercial value is obtained. It is fast to light, very nearly equaling the hydron blues in this respect. It is very slightly affected by acid, but is fast enough in this respect so that it may be used in union goods for cross-dyeing. It is also fast to perspiration and washing, while its fastness to chlorine is greater than that of any other blue dyestuff.

The dyeings outlined above do not cover the range of shades obtainable from Naphthol AS and BS, but simply serve to illustrate the wide variety possible. The comparative simplicity and ease with which they may be applied appeals strongly to mill managements, for the success of present-day dyehouses depends upon simplicity of operation. On the whole, it may be said that the usefulness of this series of colors is as yet largely unexplored, and because of their almost unlimited possibilities we may expect to see radical changes in the warp dyehouse of the future. The extremely cordial reception which has been accorded them at this early date proclaims a most successful future for Naphthol AS and BS and their allied products.

Just why certain colors please and others jar the eye will be described at the 1922 National Exposition of Chemical Industries at the Grand Central Palace, New York, on Thursday evening, September 14, by M. L. Crossley of the Calco Chemical Company, who will speak on "The Colors That Please Us."

If the chemical and chemical equipment industries which will be represented at the 1922 Chemical Exposition at the Grand Central Palace, New York, during the week of September 11-16, should cease operating for one year, every vital industry of the United States would be forced to suspend operations before the expiration of that period.

The New Physics, and the Chemistry of Dyestuffs

Imagination of Scientists—Atom a Miniature Solar System—First Theories of Dyestuffs—Constitution and Depth of Color—A Different Point of Attack—On the Nature of Light—Importance of Absorption Bands Recognized—Bands of the Infra-Red Region The Contribution of Radio

By ALLAN A. CLAFLIN

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THE New Physics differs from the Old Physics. The Old Physics had to do with matter as it was built up by chemistry. The New Physics has to do with the tiny particles of matter or energy, the electrons, before they are combined or stabilized to form the atoms and molecules of chemistry. Thus, where formerly we considered chemistry the more fundamental science, now it is seen to occupy an intermediate position.

The New Physics has a peculiar pertinence to the man interested in dyestuffs, because it is intimately associated with the phenomena of light. Without light, dyestuffs are purely of academic interest. Light itself is a sensation produced by certain vibrations or waves. A great deal is known about these waves, their length; that is, the distance from the peak of one wave to the peak of the next has been very accurately measured. What effect will be produced by waves of a certain length is known. The speed at which they travel is known. Yet waves of what? is perhaps still a debatable question. Much of our knowledge of light, heat and electricity has been built on the basis of the waves being transverse waves of a hypothetical material, ether. This hypothetical ether has always been a troublesome thing for the ordinary imagination.

Imagination of Scientists

Mr. Heywood Broun has well said that it is not to the novelists and poets one should turn for imagination; it is to the scientists and mathematicians.

One needs the imagination of the mathematician to comprehend ether, a substance at once all pervading and imponderable, perfectly elastic and intangible. It is a relief then to find that while for many purposes light waves are still referred to as ether waves, that the ether theory is approaching, if not finally reached, the discard. It is perhaps more in accord with modern thought to consider what formerly were known as ether waves to be transverse waves in streams of electrons. This is hypothetical, of course, like the ether, and it gives rise to the further question of what are electrons. To elaborate the theory, we may say electrons are centers of energy or of positive and negative electricity, which combined or held together by mutual attraction form the atoms of the chemist. It still requires the imagination of an Einstein to understand how energy becomes matter by being attracted to something as intangible as itself, and for the lay imagination it is certainly easier to conceive the electrons as being the ultimate subdivisions of matter, which charged with opposing electric forces form the atom.

Atom a Miniature Solar System

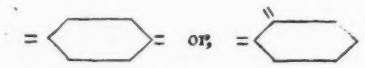
For a classifying analogy, one can consider the modern physicist's atoms to be an extremely miniature solar system with a negatively charged electron as the sun and a collection of positively charged electrons—"protons," some writers term them—as planets. In the atoms there are various suns and proportionately more planets. According to the balance, geometrical arrangement, number of component electrons develop the properties, weight, chemical activity, etc., of the atomic element.

First Theories of Dyestuffs

To return to our subject of dyestuffs, the first great dyestuff synthesis, that of alizarine, was productive of a theory of color formation, that of the leuco compounds to the effect that the addition of hydrogen negatived color formation, and that essentially the color was due to the double bonding between oxygen and nitrogen atoms, between nitrogen atoms or carbon and nitrogen atoms, etc.

As the number of dyestuffs increased, many exceptions were found to the simple double-bonding theory, and it was followed by the theory elaborated by Otto Witt, of chromogens, chromophors and auxochromes. This theory has done yeoman service in increasing the number of successful dyestuff syntheses. It has furnished a nomenclature for this particular brand of chemistry, as a scientific theory to explain wherefore it has been too vague or expansive. Armstrong to an extent worked back toward the double-bonding theory

of the alizarine synthesis when he put forward what is known as the quinonoid theory. The quinonoid group is described as a benzene nucleus to which other atoms or groups are attached by double bonds in the para or ortho positions, thus:



Constitution and Depth of Color

Nietzki contributed to the theoretical consideration of color formation observations on the relation of chemical constitution to depth of color, and promulgated the general proposition that dyestuffs can be deepened by adding groups to increase the molecular weight. Thus, in the case of rose-aniline the color is successively deepened by methylating, ethylating and phenylating. Like the theory of Witt, that of Nietzki has been productive in assisting material progress, but so many exceptions have been noted to it that it cannot be said to shed much light on fundamental theory. Thus, in the theory of the quinonoid structure and the generalizations of Nietzki, there are valuable observations, but the elaborations necessary to explain exceptions weaken them for scientific working hypotheses. Indeed, as one follows successively the theories of color formation from chemical constitution alone, it will be seen that facts accumulate, but as they accumulate they tend to complicate rather than to elucidate the question of the ultimate cause of color of dyestuffs.

A Different Point of Attack

This feeling that chemical considerations alone were getting us nowhere, has led to the problem of the relation of color to chemical constitution being attacked from another angle. This angle or direction is particularly in line with our consideration of the New Physics, as it has to do with the effect of chemical constitution on color considered scientifically as phase of light phenomena or, it rather may be said, wave phenomena, as the effect on the invisible waves has been considered as well as the visible.

In a recent monograph, "Colour in Relation to Chemical Constitution," Professor E. R. Watson has summarized and made available to the general reader the work that has been done in this field, work in which, by the way, Professor Watson himself has taken a leading part.

On the Nature of Light

Before considering the methods of this work, it may be well to digress for the moment and go back to a consideration of some of the scientific aspects of light.

As we have noted earlier, light is a sensation produced by certain waves or vibrations of an unknown something which for lack of a better term may be known as ether. If a ray or beam of white light from a primary source, as the sun, is passed through a glass prism or deflected by a surface engraved with very fine parallel lines, such a surface being technically known as a diffraction grating, it will be observed that the beam of light is spread out into a spectrum of different colors.

The colors of the solar spectrum are, of course, very well known from the natural phenomenon of the rainbow, as well as from the ease and attractiveness of amateur experiments with a glass prism. Determinations have shown that the different colors or sensations of different colors are produced by difference in wave lengths; thus, the violet end of the spectrum is the result of the shortest waves with the lengthening waves producing successively the other colors in their order, blue, green, yellow, orange and red. It is customary to speak of the spectrum produced by visible light waves as the visible spectrum, as there are waves of too short length to produce the sensation of light and also there are waves too long to produce light. A useful analogy is that of a piano keyboard in which, if one places the space of the visible spectrum as one octave, there will be found two octaves above it, and no less than twenty-four below it.

Non-visible Rays

The octaves above the visible spectrum, i. e., of the shortest wave length, are broadly known as the ultra-violet region, and the twenty-four below are known as the infra-red. The ultra-violet rays are divided into those of the shortest length, the highest octave known as Schumann rays, and the ultra-violet rays proper, the second octave, which find use in photography, surgery and are of interest to the textile chemist in "fading" lamps. In the infra-red rays are the rays of radiant heat. In the investigation of light phenomena, it has been observed that the nature of the spectrum of a light was dependent on the source of the light, or one can even say the substance producing the light, and that the spectra from the same source were always the same. By the use of a simple yet marvelous instrument, marvelous in the sense of the results obtained with it, known as the spectroscope, the spectra of all elements have been studied, as well as new elements identified. It is not so much by the spaces occupied by the respective colors that these different spectra are recognized, but in each spectrum sufficiently diluted, certain dark lines or bands are observed and with the spectrum observed on a scale, these bands for the same spectra are always found in the same relative position. These lines may be observed in the ultra-violet region and a portion of the infra-red as well as in the visible spectrum. From their discoverer, these lines are known as Frauenhofer lines, but as on magnification

they appear rather as bands than lines, it is more customary to speak of them as absorption bands.

Importance of Absorption Bands Recognized

With the development of the New Physics and the growing appreciation of the part that electronic vibrations play in the phenomena of light, the study of the absorption bands has been of increasing importance. As observed by the human eye, a dyestuff, for example, produces a red shade because all the rays of light are absorbed except the red rays, which are reflected.

In speaking of the reflection of light, it should be noticed that light is not reflected as a ball rebounds from a wall, but reflection involves a re-creation of the waves. With a connection established between waves of all lengths, absorption bands have been studied in the ultra-violet region and infra-red as well as the visible spectrum, and, as Professor Watson says, the possibilities of the infra-red, due to its magnitude, are as if a geologist hitherto only occupied with the British Isles had the whole world placed at his disposal.

Bands of Infra-Red Region

Thus far, only a beginning has been made in the infra-red region. The bands for a number of the simpler organic compounds have been placed and for some of the alkaloids. No connection has been established as yet between the absorption bands in regions other than the visible spectrum and color phenomena. As, however, this study is developing our knowledge of atomic, ionic and molecular structure, it is not merely vague imagining to expect ultimately the connection will be established. How much this may mean is as yet indeterminate. The time is probably still far distant when the composition of a dyestuff of one shade being known, it will at once be possible to produce all shades. The formulations of Nietzki will probably continue, for a long time to come, to be the guide of the research worker in color chemistry, and his work thus in a measure empirical. Yet we are at a threshold.

The Contribution of Radio

The great development of wireless telephony, radio, is an application of wave phenomena. The waves that transmit the daily "broadcast" are of the same media that cause the sensation of light and color. Their existence was predicted by Clerk-Maxwell, "the man who dreamt in mathematics," to whom we are largely indebted for our present electro-magnetic theory of light, although not actually discovered by him. These waves differ from light waves, infra-red waves, etc., only in their magnitude. While light waves are measured in tenths of millionths of meters, the radio waves are measured, as every schoolboy of to-day knows, in tens, hundreds and thousands of meters. In effect, to the phenomena of light, this is applying a magnification of many millions. As the stellar chemistry of the astronomer has by its confirmation of the theory of isotropy cleared away the long-standing mystery of fractional numbers in atomic weights, so may it be predicted that the New Physics, dealing at once with the electrons in the atom, and with the enormous vibrations of electric waves, may disclose why a complex organic structure is required to reflect or re-create those specific waves that produce to the human eye the sensation of color.

Some Aspects of the Dyestuff Industry as Seen from a Dyestuff Laboratory

More Exacting Requirements Being Met by American Products—Consumers Generally Appreciative of Unvarying Standards Maintained—Changing Demands Bring New Problems—A Plea for Broader and More Extensive Application Research

By ROBERT E. ROSE, Ph.D.

Technical Laboratory Director, E. I. du Pont de Nemours & Co., Wilmington, Del.

A TECHNICAL laboratory devoted to such complicated problems as those arising out of the application of dyestuffs, is an ideal place from which to look out upon the industry and judge of what success is being achieved.

We know here that the requirements set by the users of dyes have become very much more stringent than they used to be, and we know that these requirements are being met by American products.

A Merited Tribute from Consumers

Standardization of dyestuffs is being checked much more closely by the consumer than was customary some years ago, and yet the candid user admits that he has less reason to find fault than he had when he employed foreign products. Those in a dyestuffs laboratory know how real a tribute this is, because they know how extreme is the temptation to yield a trifle

in quality, how great is the pressure arising from the inherent difficulties of dye manufacture to put out material differing slightly in shade or strength. But we know that American dyestuff manufacturers are keeping closer to their standards than the foreign makers ever did. We have the proof of it on our shelves, where we have many pre-war samples of the same color which differ among themselves more than enough to condemn them, were we responsible for their quality.

From our point of vantage, we see that many dyestuff fashions are changing, that some colors of great pre-war importance are no longer of any consequence because the user has modified his views, that old colors have to be modified to meet new requirements. The tremendous growth of the silk and artificial silk industries is an example of new requirements—or, rather, a shift in the relative importance of problems. And we know very well how greatly the American dyestuff industry has developed our line of colors to meet new problems.

The advance during the last year has been in finer specialties, light fast scarlet, reds and blues, very fast ice colors and brilliant developed colors. Rapid progress has become a habit and receives far less attention than it did, but the handling of the problems of dyestuff users gives one a very clear idea of the very great development that has been going on.

If the users and makers of dyestuffs can only be brought to co-operate to defray the cost of real, broad-scale research devoted to the application of dyes, the American textile industry will gain very much. There is research to be done of a type which can hardly be said to belong in a dyestuffs laboratory or in our dealing with textile fibers. It is hardly to be expected that the young dyestuff industry will give itself to such research. It would not be warranted in doing so. The textile industry is in a much better position to devote money to research of this kind, which is really even more important to it than to the dye industry.

Perhaps the American Association of Textile Chemists and Colorists will find a way to further this extremely important work.

Colors Fast to Bleaching

Turkey Red Still Pre-eminent—Not All Vat Colors Will Stand Bleaching—Dyer Must Know His Materials Before Giving Guaranty—Fastness to Chlorine Not a Sure Sign of Fastness to Bleach

By H. F. SCHWARZ

Manager, Glenlyon Yarn Dye Works, Phillipsdale, R. I

BEFORE the discovery of the vat dyestuffs there were only a few coloring matters which would withstand a bleaching process such as is necessary for the production of a satisfactory white ground on gray cloth containing colored yarns. Most of the colors used were only partially fast to this treatment and the shade in the finished goods in most cases was considerably lighter than the original dyeing, a condition which made it difficult to obtain uniform results. The bleaching processes in those days were considerably milder than they are at the present time, and with one or two exceptions the fastness of the colors then used would be quite unsatisfactory for the modern processing of this class of work.

Turkey Red

One excellent color, however, was available, and even to-day it stands pre-eminent in its fastness to the most severe processes. This is a properly dyed Turkey Red, which must not be confused with Alizarine Red, often wrongly designated by the former name. They are chemically the same, but owing to the difference in method of application the fastness of the dyeings vary considerably, especially to kier boiling. A real Turkey Red will stand a kier boil with caustic soda or lime and subsequent treatment of hypochlorites, exceedingly well—which is a property not possessed by any of the so-called vat colors. The process of dyeing Turkey Red, however, is a long and tedious one, and as no other known color will stand the treatment mentioned, its uses to-day are considerably limited.

Another color used which is not so fast as Turkey Red, but which will resist present-day colored bleaches remarkably well in light shades, is Primuline, after-treated with chlorine.

Other colors used were Aniline Black, Iron Buff, Indigo, Chrome Yellow, Cutch Brown, and Alizarine Pink. These by themselves and in combination constituted a fairly good range of shades, with the exception of Helio.

Vat Dyes

The bleaching of colored yarn goods was not conducted on a satisfactory basis, however, until the vat colors were put on the market and the excellent fastness of most of these gave a great impetus to the production of this style of fabric. It is now possible to

produce with these colors almost any shade, even comparable in brightness with many of the basic colors, and possessing such excellent fastness to either chlorine or peroxide bleaching that the color in the finished goods is only very little different from that of the gray. Not all vat colors are fast to bleaching and before a dyer can guarantee such fastness he must be fully acquainted with all the properties of the individual dyestuffs and understand thoroughly the bleaching and finishing processes which may be used on the fabric as well as the processes which may be applied to the finished product.

Some people are under the impression that if a color is fast to chlorine it is fast to bleaching, but such is not the case, and there are many colors, including some of the vat dyestuffs, which will stand a chlorine treatment quite successfully but which will strip or bleed if given a treatment with a boiling soap solution.

There are colors which will stand a peroxide bleach but not one with chlorine while there are others in which the opposite is the case and it will readily be understood that great care is necessary in the selection of dyestuffs used for a fast-to-bleaching range of shades.

This class of color can be dyed not only on cotton, but on artificial silk, natural silk and, to a limited extent, on wool; although in every case the dyestuffs must be carefully selected and the dyeing processes modified to suit the fiber dealt with.

The increasing demand for better fastness, not only to bleaching but to laundering, washing and sunlight will no doubt result in a greatly increased consumption of vat colors and the converter or merchant who can guarantee the fastness of the color in his fabrics will be able to command higher prices and obtain greater stability in his sales than those of his competitors who do not follow such a procedure.

THE THEORIES OF DYEING

There have been many attempts made to account for the facts of dyeing textile fibers, and to group the explanations into a statement which would adequately cover all of the known facts So far, no one has succeeded in presenting a theory which satisfactorily explains the phenomenon of dyeing. The reason is more or less apparent. From the widely different chemical and physical nature of the two great classes of fibers, and the very different types within each class, together with the almost infinite variety of dyestuffs, it seems likely that no one theory will ever be put forward which will fully explain the processes involved in dyeing. Three theories, each of which has merits within a limited field, will be briefly discussed here.

The chemical theory states that in the process of dyeing, a chemical combination take place between the fiber and the dyestuffs, with the production of a definite substance known as the color lake. Considerable data has been collected to support this theory, especially from wool and silk. An experiment which is often referred to by the advocates of this theory is that of the action of basic magenta and wool. This red dye is manufactured by treating colorless, basic rosaniline with (colorless) hydrochloric acid; here two colorless substances have reacted to produce the familiar dyestuff. Now, if wool is boiled in a solution of the colorless rosaniline, it is dyed red just the same as if magenta had been used. In the first case the color was obtained by chemical action, then why not consider that in the second case the production of color was also due to chemical activity? In the actual dyeing of wool with magenta it can readily be shown that the dye decomposes into two constituents, the fiber absorbs the rosaniline and is dyed, but the hydrochloric acid is left behind in the dye bath. Other examples may be enumerated, but those given above prove that the chemical theory has some definite facts to support so far as wool is concerned.

The dyeing of cotton is not so easily explained. Cotton, which is comparatively chemically inert, is dyed with direct colors from a neutral bath, the addition of common or Glauber's salt merely serves to decrease the solubility of the dyestuff in water. There is little or no evidence to show that the color has combined chemically with the cotton, and for this reason, it is unwise to apply the theory in this case.

The mechanical theory supposes that dyeing involves the deposit of colored particles in the interstices of the fiber, and that the combination between dye and fiber is a mechanical one. There is little to be said in favor of the theory, aside from the fact that it may perhaps account for the dyeing of cotton with the old type of mineral pigments which are, of course, vastly different from the synthetic organic dyestuffs now in use. The valid objections to this theory are serious ones. For instance, if dyeing is merely the depositing of dye particles in the pores of the fiber, how is it that all dyestuffs do not dye all kinds of fibers? Further, how can it account for the fact that a dye may give a very fast color on one fiber, and be fugitive on another, also that a dyestuff may give quite different shades on different fibers? Some investigators have tried to answer such questions on the ground that the size of the dye particles and the fiber "pores" may account for these differences, but such assumptions introduce other and more inexplicable difficulties.

A much more plausible explanation of the facts of dyeing, is that known as the solid solution theory. First, what is a solid solution? A scientific definition may not be necessary here, but perhaps two illustrations may suffice. Molten metals have properties like liquids and have the ability to mix with certain other metals, and on cooling, a solid solution results; that is, the constituents do not separate out as individuals, but remain homogenous. For our purpose, all alloys may be considered as solid solutions. Molten glass can dissolve small amounts of certain solid pigments and when cold there results a solid solution of the pigment in glass, and the glass has a characteristic color.

According to this theory, the fiber is considered to have the property of dissolving coloring matters with the formation of a colored solid solution. A chemical reaction may or may not take place. Since all fibers are non-crystalline, and of a colloidal nature (they may be considered as somewhat like an insoluble stiff jelly) it is not surprising that they would act differently toward different dyestuffs. It is not difficult to see why the power of a fiber to dissolve colors should vary, as well as the rate of solution (actually the rate of dyeing). Whether a liquid will dissolve a given solid or mix with another liquid is often a question of temperature, while the presence and quantity of other substances is also a decisive factor. So with dyeing, the influence of temperature is in most cases extremely important, while the presence and quantity of other substances in the dye bath is usually the deciding factor as to whether a good job or a poor one will result. The fact that some colors "exhaust" much better than others may be explained by considering that the power of a fiber to dissolve dyestuffs varies within certain limits, which may be relatively high (exhaust well) or low.

While the solid solution theory appears to satisfactorily account for many of the facts of dyeing it should not, however, be considered as a complete theory since it only covers part of the field.

Three theories of dyeing have been briefly discussed, and it is apparent that no one is entirely satisfactory, in fact they are far from expressing all of the real truth They do illustrate one thing, however, for they show how very complex are the processes involved in dyeing textiles.

The art of dyeing has been practised for a long time, its great importance in catering to the natural love for color is universally recognized, yet when we are confronted with a demand for an explanation of what is involved in the processes employed, we then realize how small is our knowledge of these fundamentals.—"Canadian Dyer and Color User."

THE FUTURE OF NATURAL INDIGO

By H. E. Armstrong

The problems underlying the successful cultivation of the Indigo plant are those of agriculture generally and there is undoubtedly a secure future for Indigo as distinct from synthetic Indigotin. Not only has it a higher value as a dyestuff but it may happen that a difficulty in obtaining the raw material from which synthetic dyes are made might arise. For instance, owing to the growing use of smokeless fuels, the time will come when there will only be small amounts of coal-tar available for the use of the dyestuff manufacturer. As a result of three years' research work carried on at Bihar, India, W. A. Davis has had no particular difficulty in removing water from precipitated Indigo in order to obtain a paste containing 20 per cent Indigotin. Moreover, the paste does not change even under Indian conditions in presence of plenty of air, but on closing up packages of the paste, bacterial action begins and causes deterioration of the coloring matter. The presence of an increased amount of alkali, however, enables the paste to be kept under storage conditions. Owing to shipping difficulties it is desirable that the paste form of natural Indigo should be prepared in this country and R. B. Brown has furnished proof that a paste made from the natural product is superior to synthetic Indigotin for most dyeing purposes. It has also been found that the addition of 0.05 per cent of paranitraniline of the weight of the paste retards bacterial change almost entirely and does not interfere with dyeing processes. From the results of a series of experiments carried out by Mr. Davis at Pusa, it is concluded that the main cause influencing the production of Indican is a low proportion of nitrogen in the soil, and in order to ensure the maximum quantity of high quality plants the following three conditions must obtain: (1) A low proportion of readily available nitrogen in the soil, (2) a good supply of organic matter to furnish the necessary carbohydrate nutriment on which the development of the nodular growths on the roots largely depends, and (3) a good supply of soluble phosphate. In Bihar at the present time, the average yield of Java plant is from 50 to 70 maunds per acre and the plant is of poor quality, having only 40 to 50 per cent of leaf containing about 0.6 per cent of potential Indigotin. Since the cost of producing Indigo necessarily depends on the yield of the plant per acre it follows that the primary need in the Bihar district is an improvement in growth of the plant. As regards the question of suitable fertilizers, particular attention should be devoted to the importance of leguminous plants inasmuch as nature's method of attracting nitrogen from the air has yet to be appreciated; in the East this method should certainly be followed. The continual use of costly artificial nitrogenous manures is the outcome of the thoughtlessness and lack of observational and reasoning powers of which we have too long been guilty.—J. Roy Soc. Arts, through J. Soc. Dyers and Colorists.

William A. Durgin, of the U. S. Department of Commerce, has been a late addition to the Standardization Program of the 1922 Chemical Exposition. He will speak on The National Promise of Simplified Practice in Chemical Industries.

Brigadier General Amos A. Fries, Chief of the Chemical Warfare Service of the U. S. Army, will attend the Chemical Exposition in the Grand Central Palace and speak on Tuesday evening, September 12, taking for his topic the peace-time application of chemical-warfare gases in the extermination of forest and farm pests, with further comment on other uses of these toxic gases.

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is the greatest chemist in all the universe, and just as eons ago it instilled into vegetation the elements we now withdraw for the production of color from coal, so is it endowed with the power of destroying these selfsame colors. To the ingenuity of man falls the task of combating this, and as a result of the endeavors of the chemist the famous series known as the

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Newport Azo Eosine 2 B
Newport Roccelline
Newport Fast Red A
Newport Acid Violet 6 R
Newport Chromotrope 10 B
Newport Acid Red 2 B Extra
Newport Chromotrope 2 B
Newport Chromotrope 2 R N
Newport Acid Phloxine G
Newport Chromotrope 2 R
Newport Acid Phloxine 6 B
Newport Acid Red 6 B Extra
Newport Chrome Bordeaux R W
Newport Acid Chrome Red 3 B
Newport Chrome Red A 4 B
Newport Acid Scarlet 2 R
Newport Acid Red O T H
Newport Amaranth
Newport Croceine Scarlet 3 B X
Newport Lana Fuchsine B
Newport Croceine Scarlet M O O
Newport Acid Bordeaux B Conc.
Newport Acid Magenta B R
Newport Acid Fuchsine
Newport Chrome Orange G G
Newport Orange G G Conc.
Newport Orange A
Newport Chrome Yellow G
Newport Naphthol Yellow S
Newport Metanil Yellow
Newport Azo Yellow Conc.
Newport Fast Light Yellow 2 G
Newport Fast Yellow G L
Newport Fast Wool Yellow G
Newport Chinoline Yellow
Newport Chrome Green N
Newport Naphthol Green
Newport Fast Milling Green B
Newport Acid Green B Conc.
Newport Wool Green S A N
Newport Acid Chrome Blue G
Newport Azo Chrome Blue B R
Newport Azo Chrome Blue B
Newport Acid Blue L D G
Newport Acid Blue L D R
Newport Acid Blue R
Newport Wool Blue M B
Newport Fast Wool Cyanone 3 R
Newport Neutral Wool Blue R G
Newport Acid Blue G R Conc.
Newport Alkali Blue B Powder
Newport Acid Violet 4 B S
Newport Acid Violet 4 B M
Newport Acid Violet 5 B Conc.
Newport Fast Acid Violet 10 B
Newport Chromate Brown B B
Newport Chrome Dark Brown M
Newport Chrome Brown S W R
Newport Chrome Blue Black B V Conc.
Newport Chrome Blue Black V Conc.
Newport Naphthylamine Black V
Newport Wool Black B
Newport Fast Acid Black N 2 B
Newport Azo Dark Green B
Newport Acid Jet Black B X Conc.
Newport Acid Black 4 A N
Newport Acid Blue Black Extra Conc.
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Conc.
Newport C 4 B
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Conc.
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Newport Diage 2 R
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Newport D Yello
Newport Yellow
Conc.
Newport Chrine Ex
Newport Diow G
Newport Diow 3 C
Newport Diow G
Newport Diow S
Newport Diow 4 C
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als. also useful for silk, paper, leather, etc.

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nc.
rt C 4 B
rt C R
rt D 2 B
rt D Scarlet 6 B X
rt Diet R
rt Diet B
rt Burine 10 B
rt TDrange G R
nc.
rt D Orange R S
rt Dge 2 R
rt Dge 2 R G
rt Dge R
t Extra Conc.
t D Yellow N N
t Bllow Extra
ic.
t Cine Extra
t Dow G
t Dow 3 G
t Dow G F A
t Dow S W
: Dow 4 G C
: De Yellow S
: Dn 2 Y C
: Dn B
: Dn C Y
: Dn G
Dn 2 G B
Dliant Blue G
De 2 B G

Newport Direct Blue 2 B Conc.
Newport Direct Blue B R Conc.
Newport Direct Fast Blue R W
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Newport Direct Fast Blue S F F
Newport Direct Fast Blue 2 G L
Newport Direct Sky Blue
Newport Direct Sky Blue 5 B F
Newport Direct Sky Blue 10 B
Newport Direct Blue 3 B
Newport Cadet Blue
Newport Direct Sky Blue F F
Newport Direct Sky Blue 6 B Conc.
Newport Direct Blue B X G
Newport Direct Blue B X
Newport Direct Violet N
Newport Direct Brillian Violet R Conc.
Newport Direct Fast Brown M
Newport Direct Brown M B
Newport Direct Brown V M
Newport Direct Brown C R
Newport Direct Brown G X R
Newport Direct Brown G N
Newport Direct Brown R X N
Newport Neutral Grey G
Newport Fast Silk Grey M Conc.
Newport Artificial Silk Black S B R
Newport Direct Black E G Extra
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The underlying theories and principles of chemistry are the same, no matter to what industry the application is eventually made. Furthermore, no industry involves more advanced and varied applications of the science of chemistry than those of the manufacture and application of the coal-tar coloring matters. In addition, the textile colorist must consider the complex composition of the textile fiber, and the obscure reactions which take place between them and the other materials of the textile industry.

During the first year the general chemistry, including both inorganic and organic, is taught by lectures and laboratory work, and this is supplemented during the second term by qualitative analysis and stoichiometry.

Advanced inorganic chemistry, as well as advanced organic chemistry, is studied during the second and third year as a continuation of the elementary chemistry of the first year, and much time is spent upon quantitative analysis, industrial chemistry, and textile chemistry and dyeing.

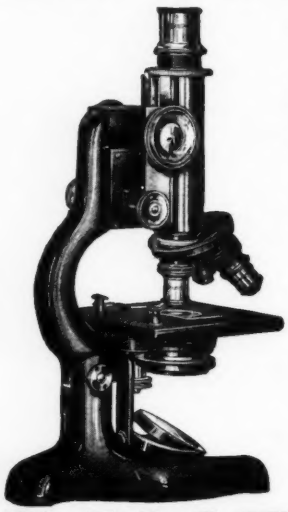
The foundation work in general chemistry is continued during the third year with courses in physical chemistry, organic laboratory work and analytical work. The subject of industrial chemistry is introduced, and much time is devoted to advanced textile chemistry, dye testing, color matching, calico printing and woolen, worsted and cotton finishing.

The fourth year is characterized by an endeavor to present certain subjects of a more applied nature in such a manner that the student's reasoning power and ability to apply the knowledge gained during the first three years may be developed to the fullest extent. The subject of engineering chemistry is introduced, and the work in the Dyeing and Analytical Laboratories is applied as far as possible to the actual requirements of the factory chemist and colorist. The student is given a thorough course in microscopy, photomicrography and the use of the various instruments, such as the spectroscope, ultra-microscope, polariscope, tintometer, etc., which often prove of vital importance in the advanced study of textile chemistry. During this fourth year the student devotes much time in the Organic Laboratory in the manufacture of dyestuffs. He must also devote much time to research work, or the original investigation of some assigned subject, upon which he must present a satisfactory thesis or report before receiving his degree.

Fall term commences September 25, 1922. Certificates covering the proper number of points accepted from High Schools and Academies approved by the New England College Entrance Certificate Board or the Board of Regents of New York. Other courses in *Textile Engineering; Cotton, Woolen, and Worsted Manufacturing; and Textile Designs* Evening courses in all departments.

Detailed information upon application

Do You Guess or Know?



In dyeing, bleaching and finishing operations, the difference between knowing and guessing is largely a question of the extent to which efficient laboratory control is substituted for "rule of thumb" methods. One faulty operation may ruin thousands of dollars' worth of materials.

In order to function efficiently the laboratory must be complete and modern in every respect. To skimp expenditures on laboratory equipment is the acme of false economy.

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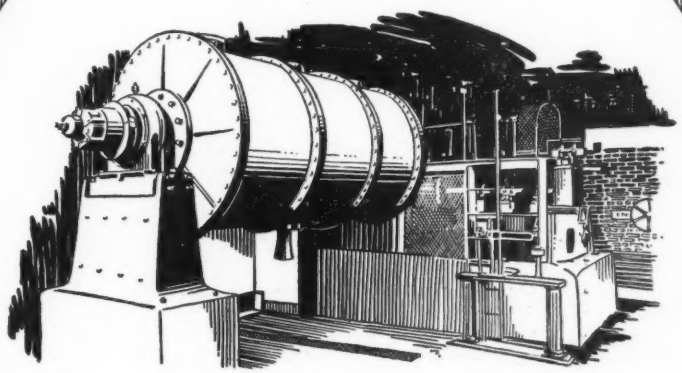

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